

REPORT  
OF  
JOHN B. JARVIS, ESQUIRE,  
RELATIVE TO  
THE SURVEY OF THE PROPOSED  
CAUGHNAWAGA CANAL.

AND  
DOCUMENTS

RELATIVE TO  
THE SURVEY AND IMPROVEMENTS  
OF  
THE RAPIDS OF THE RIVER ST. LAWRENCE,

BY  
MESSRS. MAILLEFERT AND RAASLOFF,  
CIVIL ENGINEERS.

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QUEBEC.

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1855.







# RETURN

TO AN ADDRESS from the Legislative Assembly of the 28th ultimo. For copy of Mr. Jarvis' report relative to the survey of the proposed Caughnawaga Canal, and the amount of the cost of such survey as submitted by the said Engineer (Mr. Jarvis.)

By Command,

GEO. E. CARTIER,  
Secretary.

Secretary's Office,  
Quebec, 20th March, 1855.

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*Copy of a Report of a Committee of the Honorable the Executive Council, dated 18th October, 1854, approved by His Excellency the Governor General in Council on the same day.*

On the report of the Chief Commissioner of Public Works, stating that several Petitions to your Excellency from various localities in Upper and Lower Canada, for the construction of a Canal to connect the St. Lawrence with Lake Champlain, have been referred to his Department, that the Legislative Assembly also by its resolution of the 6th of April, 1853, called your Excellency's attention to the subject, that the petition from the Montreal Board of Trade, also referred to that Department, requests that a survey be made by Government of a convenient site for the Canal in question at such a place that vessels going to or coming from sea may navigate through the St. Lawrence and such Canal to Lake Champlain, that he has carefully perused these Petitions and Resolution, and also the papers relating to the matter of record in his office; that a survey was made in 1847, at the request of certain individuals who contemplated to construct the Canal as a private enterprize, and that such survey was confined to a particular line with its terminus at Caughnawaga, above Montreal, so as to be within the locality these persons had in view; that he is of opinion, considering the great importance of the subject, that a new survey should be made without delay by competent engineers, who should report as to the most convenient site for the said Canal; and the probable cost thereof; and requesting that authority may be given to the Commissioners of Public Works to have the survey effected.

The Committee recommend that authority be given to the Commissioners of Public Works to cause a survey to be made for the purpose of ascertaining the most eligible and convenient route for a Canal, from some point on the St. Lawrence to Lake Champlain.

Certified.

(Signed,)

W. H. LEE,  
C. E. C.

To the Honorable  
The Commissioner of Public Works,  
&c., &c., &c.



## INSTRUCTIONS FOR J. B. JARVIS.

PUBLIC WORKS,  
 QUEBEC, 12th August, 1854.

SIR,—As you have been pleased to signify your willingness to undertake the duties connected with the location of the contemplated line of Canal between the River St. Lawrence and Lake Champlain, in the performance of which the Commissioners of this Department were most desirous to have the benefit of the counsel and experience of a gentleman of such admitted high standing, it now becomes necessary that you should be informed as to the points upon which your opinion and advice is more immediately sought for.

The advantages to this Province which are calculated upon from the construction of this Canal are fully set forth in the Annual Report of this Department to the Legislature for the year 1852, in pages 32 to 38. A copy of this Report is herewith transmitted. By reference to it you will perceive that the objects aimed at are :—

To complete the chain of Canals already in use, and to render them profitable as well as a convenience to the Province.

To enable our Canals to compete successfully with the Erie Canals, and the Railways on the south bank of the St. Lawrence, in the transport of property to and from the Atlantic Seaboard in the United States, and with the Western States and Canada.

To furnish a cheaper, quicker, (and from reduced transshipments) a more desirable route to the great trade which passes between tide water in the Hudson River, the Railways in New England and the City of New York on the one hand, and the Western States and Canada on the other; and thus to bring traffic and tolls to the St. Lawrence Canals, which, by the competition of the Oswego and Erie Canals, and the Ogdensburg and other Railways, and the want of an efficient connection between them and Lake Champlain, obtain scarcely any of the transit trade between the Atlantic and the Western States or Canada.

To enhance the value of one of our great staple exports (lumber,) by furnishing a direct, cheap, and capacious connection between the great lumbering districts of the Ottawa, the Upper and Lower St. Lawrence, and the greatest lumber mart in the world, that of Albany and Troy.

By connecting Lake Champlain with the St. Lawrence upon an efficient scale, to open the districts upon that Lake to the sea, via Quebec, and afford them a shorter and cheaper route for imports of coal, iron, salt, fish, oil, &c., which articles can be had down at Quebec at cheaper rates than at any other American port, in consequence of the larger amount of tonnage entering inwards in ballast.

Such were some of the principle objects considered attainable by the construction of this work, in 1852, when the Report alluded to was written, but the Commissioners are of opinion that the altered circumstances under which the Province will be placed by the passing of the Reciprocity Act, and the opening of the River St. Lawrence to our American neighbors, afford increased and strong grounds for belief in the great importance of this work for the development of the resources of the country.

Your views upon the points embraced in the foregoing are particularly requested, especially with respect to the trade of the Great West, its channels, whether in use or in course of construction, the changes that are likely to take place in a great portion of it, as regards its transport eastward by the Lakes and Rivers, instead of down the Mississippi, upon the completion of the several lines of navigation and railways leading from the interior to those Lakes; and the probable



proportion of it which may be induced down the proposed canal, for the supply of the Eastern States, the West Indies, &c.

Your opinion also as to how far such trade may be interfered with, or competition formed by the several lines of Railway North and South of the Lakes and River now made, or in course of construction, will also be considered valuable, not only from your intimate knowledge of that trade and section of country, but as President of an important Railway there.

The next point on which your well-considered opinion is requested is the general location of the line, and particularly its terminus on the St. Lawrence. Upon this much difference of opinion exists, traceable, in a great measure, to the separate or local interests of the several sections of the Province.

As the Commissioners desire that this question shall be decided unbiasedly, and solely upon grounds connected with the accommodation and facilities for the contemplated trade, together with the engineering difficulties or otherwise, which may be found to exist: it is well merely to state that some advocate the line to start from Sane Point, on the Beauharnois Canal, thereby, as they suppose, to carry such a level as would overcome the summit between the two waters at the least expense; others urge the selection of Caughnawaga, opposite the head of the Lachine Canal, as being the place most convenient for the Ottawa trade. The interests of Montreal naturally desire its commencement at some point opposite or a little below that city, the population, trade and importance of which must necessarily command due attention; and, finally, there is a party who consider that the route of the Richelieu River should be that decided on.

The advantages and disadvantages of each of these propositions will, no doubt, be duly perceived and weighed well by you, prior to your coming to a conclusion.

The third point to which your attention is requested is as to the depth of water and dimensions of the Lock and Canal which it may be in your opinion the most advisable to adopt, and an approximate estimate of the cost of the work, the nature of the trade to be calculated on, the class of vessels suited for it, the capacity of the present Canals, and the capabilities of the harbours on the Lakes, will, no doubt, materially govern your decision on this point, which is more important, as by the scale of this Canal, will be determined also, that of the enlargement or new branch of the Welland Canal, a work which it is believed must be undertaken at no distant day.

Besides the foregoing the Commissioners will be obliged by receiving your views and advice upon any other branch of the question that you may think necessary to touch on.

It is most desirable that your Report should be received at as early a day as the efficient discharge of the duty will permit, with a view to which you will make such arrangements as you may deem expedient.

I am,

Sir,

Your most obedient servant,

(Signed,)

J. CHABOT,

Chief Commissioner Public Works.

J. B. Jarvis, Esq.,  
Engineer.



STATEMENT shewing the cost of a Survey for a Canal to connect the River St. Lawrence with Lake Champlain:

Amounts paid Samuel Gamble, as Engineer, 221

	days <i>a</i> 30s.....	£331 10 0			
	Travelling expenses,.....	19 17 3			
			351	7	3
"	" Wm. D. Jarvis, leveller, 199 days <i>a</i> 15s.	149 5 0			
	Travelling expenses, .....	19 18 4			
			169	3	4
"	" W. G. Pemberton, assistant leveller, 181 days <i>a</i> 12s. 6d.....	113 2 6			
	Travelling expenses,.....	10 9 6			
			123	12	0
"	" E. E. Lindsay, Compass Man and Rod-man, 181 days <i>a</i> 12s. 6d.....	113 2 6			
	Travelling expenses,.....	9 19 11			
			123	2	5
"	" G. Bathgate, Rod-man, 179 days <i>a</i> 12s. 6d. ....	111 17 6			
	Travelling expenses,.....	5 8 11			
			117	6	5
"	" W. U. Graddon, Surveyor, 142 days <i>a</i> 20s.....	142 0 0			
	Travelling expenses,.....	11 2 11			
			153	2	11
"	" Andrew Hickory, Axe-man, 10½ days, <i>a</i> 7s. 6d.		3	18	9
"	" Peter Hondit, " 131 " <i>a</i> 7s. 6d.		49	2	6
"	" Michel Kelly " 128 " <i>a</i> 7s. 6d.		48	0	0
"	" Thomas Stapleton, " 96 " <i>a</i> 7s. 6d.		36	0	0
"	" James Bell, " 80 " <i>a</i> 7s. 6d.		30	0	0
"	" Samuel Bell, " 86 " <i>a</i> 7s. 6d.		32	5	0
"	" Wm. Smith, " 5 " <i>a</i> 7s. 6d.		1	17	6
"	" Robert Chaloux, " 9 " <i>a</i> 7s. 6d.		3	7	6
"	" B. Tremblay, " 37 " <i>a</i> 6s. 3d.		11	11	3
"	" Henry Phillips, " 49 " <i>a</i> 6s. 3d.		15	6	3
"	" J. Fréchette, " 30 " <i>a</i> 6s. 3d.		9	7	6
"	" Louis Dubois, " 26 " <i>a</i> 7s. 6d.		9	15	0
"	" M. Malarky, " 25 " <i>a</i> 6s. 3d.		7	16	3
"	" J. Chaloux, " 2 " <i>a</i> 7s. 6d.		0	15	0
"	" A. Boivin, " 3 " <i>a</i> 7s. 6d.		1	2	6
"	" D. Leger, " 1 " <i>a</i> 7s. 6d.		0	7	6
"	" Amable Boivin, " 5 " <i>a</i> 7s. 6d.		1	17	6
"	" J. Sansoucie, " 1 " <i>a</i> 7s. 6d.		0	7	6
"	" An Indian, " 2 " <i>a</i> 7s. 6d.		0	15	0
"	" Canoe and Indians,.....		1	12	6
"	" A. Duvergier, Axeman,..... 5 days <i>a</i> 10s.		2	10	0
"	" Es. Chaloux, " 6 " <i>a</i> 7s. 6d.		2	5	0
"	" Albert Rounds, Horses and Waggons,.....		87	10	0
"	" F. Monett,.....do.....		4	15	0
"	" M. Riley,.....do.....		10	18	9
"	" E. H. Tracey, Stationery, &c.,.....		27	8	9½
"	" Thomas Hewitt,.....do.....		1	8	1
"	" Rent for two Rooms for Offices, .....		15	0	0
"	" Sundry persons for Stationery, Tools, Maps, Flag, Poles, Drawing Board, &c... ..		70	17	7½
			£1516	12	7



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AMOUNT of Accounts received but not yet paid.

John B. Jarvis, Professional Services as Civil Engineer,.....	2500 0 0
E. H. Tracey, Engineer in charge of Survey, Six months at £150 per month,.....	900 0 0
Hotel and Travelling Expenses,.....	139 15 0
	3539 15 0
	£5056 7 7

MONTREAL, 13th February, 1855.

To J. B. Jarvis,  
Civil Engineer.

SIR,—In accordance with your letter of instructions, dated 16th August, 1854, I came to this City, and delivered the letter of introduction you furnished me with, to the Hon. H. H. Killaly, who immediately furnished me with a party of assistants. And I proceeded at once to make the necessary examinations, and surveys, to make an estimate of the cost of building a Ship Canal to connect the navigable waters of Lake Champlain, with the River St. Lawrence.

I have made a careful examination of the several lines reported upon; they have been examined with reference to the kind of material to be excavated (by sinking test pits) as well as the quantities that would have to be moved in building the work.

It is probable that the entire amount of the different kinds of work, on either of the lines, will not vary much, from those given in the estimate.

The estimates have been made for a Canal with 80 feet of width at bottom, slopes of two horizontal, to one vertical, with banks, sixteen feet high, and calculated in ordinary times, for eleven feet depth of water, and during the seasons when there may be unusual high water in the St. Lawrence, and the Lakes, to be used with twelve feet of water. The Locks to be 230 feet long, on the clear between the gates, and 36 feet wide, with one foot less depth of water on the Mitre Sills than there is depth of water in the Canal.

The Aqueducts and Culverts are all of sufficient dimensions to allow the Canal of the full size to pass over them.

The masonry in the Locks, Aqueducts, and Culverts, is estimated for on the supposition that it is to be of the first quality; stone masonry laid throughout in Hydraulic cement mortar; the face stones in the locks to be cut so as to lay to one-fourth of an inch join; the backing to be rubble work.

The Aqueducts to be rubble masonry, piers and abutments with wooden trunk. It is expected that the masonry of the piers and abutments will be made of large stone, laid in courses, through it is not intended that every stone shall fill the full depth of the course in which it is laid, but that the course may be made of one or two stones in depth.

The masonry of the Culverts to be rubble, except the bottoms and wing walls; the bottom arch to be of cut stone, founded on concrete masonry; the Wing wall to be laid dry.

The estimated price for lock walls is \$8 per cubic yard; Aqueduct masonry \$7 per cubic yard; Culvert masonry, \$10 per cubic yard; Concrete in foundation, \$5 50c. per cubic yard. Dry wall in wings of Culverts, \$2 50c per cubic yard. The price for Culvert masonry is high, in consequence of its being necessary to put in concrete foundations, and a cut stone arch in the bottom, as nearly all the streams that they are intended to pass, are entirely dry during a great part of the summer.



The first line estimated on, is by the way of the Chambly Canal and River Richelieu. There are several bars in the river between Rouse Point and St. Johns, which will have to be dredged, to give a uniform depth of ten feet of water during the low stages in the Summer and fall. In the aggregate these will not amount to more than ( $2\frac{1}{4}$ ) two and one-fourth miles in length, and are of a soft material, that may be easily dredged.

At St. Johns it will be necessary to build a new Pier, to make a proper harbour for vessels, and for the reconstruction of rafts going South. It is proposed to build a new Guard Lock to the east of the present one, at about the same point on the River, and retain the present one as a sluice to pass water into the new Canal, and to enlarge the present Canal, from the Guard Lock to the head of Lock No. 2. For a great part of this distance, the present Canal is built in the River. It is proposed to enlarge that portion of it along the river, by building a bank in the outside of the present tow-path, except at some points where it may be necessary to cut into the points, to procure material, and to preserve a good line.

The present Canal is made for the most of the distance, opposite the Island of St. Therèse, by using the West channel of the river. The estimates are based on the supposition, that this channel will be used to the end of the Island, and the Canal continued in the River below it for 3800 feet lineal, by constructing a new bank for that distance, from this point, it is intended to cut a new Canal for 2000 feet, joining the present Canal at the waste weir, just south of Hatt's Mills; by this arrangement the river or wide reach will be extended for about a mile further than it is now used. The bottom of that part of the river which would be brought into use by this extension, is lower than the bottom line of the Canal, so that no excavations would be needed to get the proper depth of water in the Canal.

Where the banks of the enlarged Canal will have to be made in the river, provision has been made in the estimate for substantial retaining wall, and at those places where the water is deep, the estimate provides for crib work to found the wall upon. From Lock No. 2, to Chambly basin, I have made an estimate for an entire new Canal, to be located on the west side of the present Canal, keeping close to it, until it comes near Chambly, where it will curve into the basin at the south side of the present Locks, coming as close as possible to them. It is intended to make the same number of Locks, and of the same lift as those now in use; by this arrangement the Canal can be enlarged, and brought into use, without interfering with the navigation of the present Canal. The Locks on the present Canal will be valuable as sluices for the enlargement.

From soundings that I have had made in the river below Chambly, it is evident, that by raising the Dam at St. Ours four feet, it will give ten feet of water at all points on the river, during the driest times. For nearly the whole length of the river, the water is of a much greater depth. The bars which form the present shoals, are of a material which might be dredged, but it is probably cheaper to raise the dam, than to improve the navigation by dredging, and the estimates have been prepared with this view.

The second line estimated on, is from St. Johns to Longueuil. The line will follow over the same ground that would be occupied by the Chambly enlargement for  $8\frac{3}{4}$  miles from St. Johns. It then bears off to the west at the foot of the high ground or hill, known as the "Grand Coteau," and follows the foot of that high ground, until the line crosses the Little Montreal River, at which point it turns to the north and runs in a line almost straight to Longueuil, terminating in the St. Lawrence at the west side of the dépôt of the Grand Trunk Railroad Company.

Immediately after leaving the Chambly Canal, a little heavy cutting occurs for a few hundred feet. After passing this cut to the Little Montreal River, a distance of about five miles, the country is favourable for a wide Canal, and it



would add but little to the expense, to make it from 150 to 200 feet wide. After passing the Little Montreal River, low ground is encountered for about  $2\frac{1}{2}$  miles, and as the work will be principally embankment, it will be as cheap to make the Canal from two to three hundred feet wide, as of any narrower width, beyond this the cutting is more than enough to make the banks. It would materially increase the expense to make a channel of more than the ordinary size. A considerable rock cutting is found on the north end of this line, which cannot be avoided. I had examinations made to find a shorter line, but was entirely unsuccessful.

The third line estimated on is from St. Johns to Caughnawaga, with the Champlain level as a summit. This line will follow over the same ground that would be occupied by the Longueuil Canal, until it crosses the Little Montreal River, and from there continues on at the foot of the hill, which, with a few breaks extends to Caughnawaga. There are few places where heavy cutting is encountered for short distances, but the greater part of the way, a Canal 150 to 200 feet wide might be made as cheap as a narrow one.

The St. Lawrence near Caughnawaga has many bars and shoals in it, no practicable place could be found to terminate the Canal until after passing more than  $1\frac{1}{2}$  miles to the west of the Village, at this place there is a broad, deep channel, extending across the whole river, having its other terminus at the head of the Lachine Canal. In sounding the river, no place was found in this channel between the South Shore and the Steamboat Channel with less than fifteen feet of water. I have sounded the river with great care, with a view of getting a terminus further east, and am satisfied that there is no safe place between this point and the Lachine rapids, to make a safe Terminus. There is but little heavy work at any point on this line. The materials are all of a good quality for building a Canal. The line, after leaving the Chambly Canal, is very straight, though it forms quite a circuit to get round the north-east point of the "Grand Côtéau."

The Fourth Line estimated upon is in almost a direct line from St. Johns to Caughnawaga. It commences just north of the Barracks at St. Johns crossing the Railroad at the south of the passenger dépôt, it then follows at the west side of the Railroad, and parallel to it for three miles, where it bears off in a westerly direction in almost a straight line, to within four miles of its terminus at the St. Lawrence, at this point it takes a more northerly direction, and runs in a direct line to the St. Lawrence, terminating at the same place that was selected for the Champlain level to terminate.

By this line it will be necessary to ascend three locks to the summit. These locks will all be within two miles of St. Johns. The descent is by five locks which are all within four miles of the St. Lawrence. All the locks are of  $12\frac{1}{2}$  feet lift each. The short levels are all long enough to make good reaches for navigation.

The summit on this line will have to be supplied by a feeder from the St. Lawrence, taken from some point further west. In accordance with your instructions, I have made an estimate for the feeder, to be the same size as the Canal, and to be navigable, and also another estimate for a feeder of smaller dimensions, intended only to be of sufficient size, to supply the Canal with water.

The Country from St. Johns to Caughnawaga and Beauharnois on this route, is of a very favorable character to build a Canal in. The excavation will generally be easy, and the material good for water tight works.

The only place that Rock will be found in the excavation of this line of Canal, is near Caughnawaga, and there is but a small quantity at that place, no Rock will be found in the excavation for the feeder.

This line of Canal and navigable feeder might be made wider than the regular size, for a great part of their length without increasing the expense. In some



places it will necessary to increase the width, to get the materials for the banks. For a large part of the distance it can be made 200 to 250 feet wide, as cheap as any less width.

For the cost of the different lines, I would refer to the accompanying estimates, and for a more correct knowledge of the differentes routes, to the accompanying Maps.

I have been aided in this survey by the following assistants, Messrs. Samuel Gamble, William D. Jarvis, William G. Pemberton, George E. Lindsay, George Bathgate, and W. U. Graddon, who have conducted their several duties with a highly commendable intelligence, industry and fidelity.

Respectfully yours

(Signed,)

EDW. H. TRACY.  
Civil Engineer.

### ESTIMATE of cost of the proposed St. Lawrence and Champlain Canal.

*First*,—By enlarging Chambly Canal, and improving the navigation of the River Sorel.

Dredging bars in River between Rouse's Point and St Johns.....	140,000 cbc. yds.	a 25 c.	\$35,000	
New Pier at St. John.....			50,000	
Excavation of earth.....	1,786,000	" a 30 c.	535,800	
" " .....	470,000	" a 20 c.	94,000	
" Rock.....	107,000	" a \$1 25 c.	133,750	
" " .....	112,000	" a 75 c.	84,000	
River Wall.....	32,000	" a \$1 00	32,000	
" " .....	25,600	" a \$1 50	38,400	
Stone filling.....	14,600	" a 75 c.	10,950	
Crib Work.....	1,105,000 cubic feet	a 4 c.	44,200	
Clearing out River Reach and building new Tow Path.....	13,600 lin. feet	a \$1,00	13,600	
New Road.....	2 miles	a \$1,000	2,000	
Two Stone Culverts.....			12,100	
One Waste Weir.....			5,000	
Seven Draw Bridges.....	7	a \$3,000	21,000	
Lockage .....	73 feet	a \$5,000	365,000	
One Guard Lock.....			40,000	
Pier at Chambly.....			5,000	
Stone Protection Wall in- side of Canal.....	11.8 miles	a 20,000	236,000	
Raising St. Ours Dam 4 ft. & Lengthening Lock			75,000	
			<hr/>	1,832,800
And for contingencies and Engineering ten per ct ..				183,280
				<hr/>
Total Cost				\$2,016,080



*Second.—By enlarging part of the Chambly Canal, and building new Canal for the remainder of the distance to Longueil.*

Dredging bars in River between Rouse's Point and St. Johns.....	140,000 cubic yards, a	25c.	\$	35,000	
New Pier at St. Johns.....				50,000	
Excavation of earth.....	1,484,000	" a	30c.	445,200	
" " .....	106,000	" a	25c.	26,500	
" " .....	3,650,000	" a	20c.	730,000	
" rock.....	107,000	" a	\$1 25c.	133,750	
" " .....	276,000	" a	\$1 00c.	276,000	
" " .....	112,000	" a	75c.	84,000	
River Wall.....	32,000	" a	\$1 00c.	32,000	
" .....	25,600	" a	1 50c.	38,400	
" .....	2,700	" a	2 00c.	5,400	
Stone filling.....	14,600	" a	75c.	10,950	
Crib Work.....	1,105,000 cubic ft.	a	4c.	44,200	
Clearing out River Reach and building new Tow-path.....	13,600 lineal ft.	a	1 00c.	13,600	
New Road.....	2 miles	a	\$1,000	2,000	
One Waste Weir.....				5,000	
Eight Culverts.....				44,000	
One Guard Lock.....				40,000	
Lockage .....	72 feet	a	\$5,000	360,000	
Six Sluices.....	6	a	5,000	30,000	
Montreal River Aqueduct.				39,000	
One Rail Road Drawbridge				5,000	
Fourteen Road Bridges....	14 "	a	3,000	42,000	
Pier at Longueil.....				100,000	
Stone protection wall inside of Canal.....	28.28 miles	a	20,000	565,600	\$3,157,600
And for Contingencies and Engineering, ten per cent					315,760
Total Cost.....				\$3,473,360	

*Third.—By enlarging part of the Chambly Canal, and building new Canal, for the remainder of the distance to Caughnawaga.*

Dredging bars in River between Rouse's Point and St. Johns.....	140,000 cubic yards, a	25c.	\$	35,000	
New Pier at St. Johns.....				50,000	
Excavation of Earth.....	1,484,000	" a	30c.	445,200	
" " .....	1,534,000	" a	25c.	383,500	
" " .....	3,263,000	" a	20c.	652,600	
" Rock.....	107,000	" a	\$1 25c.	133,750	
" " .....	222,000	" a	1 00c.	222,000	
" " .....	112,000	" a	75c.	84,000	
River Wall.....	32,000	" a	1 00c.	32,000	
" .....	10,000	" a	1 00c.	10,000	
" .....	25,600	" a	1 50c.	38,400	



" .....	2,700	" a	2 00c.	5,400
Stone filling.....	14,600	" a	75c.	10,950
Crib Work.....	1,105,000 cubic ft.	a	4c.	44,200
Clearing out River Reach and building New Tow- path .....	13,600 lineal ft.	a	1 00c.	13,600
New Road.....	2 miles	a	\$ 1,000	2,000
Waste Weir.....				5,000
Two Sluices round Locks..	2 feet	a	5,000	10,000
Nine Culverts.....				62,500
Montreal River Aqueduct.				39,000
St. Phillippe "				21,000
La Tortue "				36,000
St. Pierre "				21,000
Guard Lock.....				40,000
Lockage.....	25 feet	a	5,000	125,000
Two Sluices.....	2 "	a	5,000	10,000
Two Rail Road Bridges...	2 "	a	5,000	10,000
Twenty-one Road Bridges	21 "	a	3,000	63,000
Pier at Caughnawaga.....				50,000
Altering Rail Road.....				25,000
Stone Protection Wall in- side of Canal.....	34.46 miles	a	20,000	689,200
				<hr/>
Add for Contingencies and Engineering ten per cent.				\$3,369,300 336,930
				<hr/>
Total cost.....				\$3,706,230

*Fourth.—By building a Canal from St. Johns to Caughnawaga on a direct line, with a navigable feeder from the Beauharnois Canal.*

Dredging bars in River be- tween Rouse's Point and St. Johns....	140,000 cubic yards,	a	25c.	\$ 35,000
New Pier at St. Johns...				20 000
Excavation of earth... ..	1,700,000	"	a 25c.	425,000
" " .....	3,950,000	"	a 20c.	790,000
" rock.....	50,000	"	a \$1	50 000
Montreal River Aqueduct				39,000
St. Phillipe, "				21,000
La Tortue, "				36,000
St. Pierre, "				21,000
Ten Culverts,				85,000
Lockage,.....	100 feet	a	\$ 5,000	500,000
Sluices,.....	8 "	a	5,000	40,000
Two Railroad Bridges.....	2	a	5,000	10,000
Twenty-five Road Bridges.	25	a	3,000	75,000
Protecting wall inside of Canal.....	25.57 miles	a	20,000	511,400
Pier at Caughnawaga.....				50,000
				<hr/>
				\$ 2,708,400
Add for Contingencies and Engineering, ten per cent.				270,840
				<hr/>
Total cost without Feeder,				\$ 2,979,240



## NAVIGABLE FEEDER.

*From Beauharnois Canal.*

Excavation of earth.....	790,000 cubic yards, <i>a</i> 25c.	197,500	
“ “ .....	1,951,000 “ <i>a</i> 20c.	390,200	
Chateauguay Aqueduct...		125,000	
St. Louis, “ .....		60,000	
Culverts.....	10	45,000	
Ten road Bridges.....	10 <i>a</i> 3000	30,000	
Stone Protection wall inside of Canal.....	16.19 miles <i>a</i> 20000	323,800	
		<hr/>	1,171,500
Add for Contingencies and Engineering, ten per cent.			117,150
			<hr/>
			1,288,650
Cost of line without Feeder,			2,979,240
			<hr/>
Total cost,			\$ 4,267,890

*Fifth.—By building a Canal from St. Johns to Caughnawaga on a direct line with a feeder from the Beauharnois Canal that is not navigable.*

As above.....			2,979,240
Feeder from Beauharnois Canal not navigable.			
Excavation of earth.....	790,000 cubic yards, <i>a</i> 25c	197,500	
“ .....	1,951,000 “ <i>a</i> 20c	\$390,200	
Chateauguay Aqueduct...		125,000	
St. Louis “ .....		60,000	
Culverts “ .....	10	45,000	
Ten road Bridges.....	10	30,000	
		<hr/>	
Total as in last account,		\$ 847,700	
		<hr/>	
Say for feeder not navigable, cost one-third of the above or.....		280,000	
Add ten per cent as before		28,000	
		<hr/>	\$ 308,000
Total cost,		\$3,287,240	

*Sixth.—By building a Canal from St. Johns to Beauharnois on a direct line without branch to Caughnawaga.*

Dredging bars in River between St. Johns and Rouse's Point. ....	140,000 cubic yards, <i>a</i> 25c.	\$ 35,000
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*To the Honorable the Commissioners of Public Works for the Canadian Government.*

GENTLEMEN,—By your instructions dated August 12th, 1854, I am called upon to make examinations and report on a proposed Canal to connect the St. Lawrence River with Lake Champlain; and also, on questions of trade, and engineering on this and works in connection that will be involved with this enterprise. The general practicability of the work is not questioned, and as several matters relating to the proposed Canal will materially depend on the views that may be taken of its connections, it has appeared proper to discuss them in the first place.

The Report of your Board referred to in your instructions has been carefully considered, and you will judge of its influence on my mind, by observing the tenor of this communication.

It is proposed to consider the several matters embraced in your instructions in the following order:

- 1st. The Western Trade, and the influence of Railways on the same.
- 2nd. The competition the Canada improvement must experience for the Western Trade.
- 3rd. The dimensions of Canal and Locks, best adapted for the navigation.
- 4th. The Lumber and other Canadian trade.
- 5th. The question of tonnage and revenue.
- 6th. A description of the several routes for the proposed Canal, with approximate estimates of cost.
- 7th. The advantages of the several routes proposed, for the trade that is to be accommodated.

First.—The Western trade.—This is understood to be the trade that centres on the great Lakes, that form to a large extent the boundary between Canada and the United States, and seeking an Atlantic market.

From early engagement in the Public Works of the State of New York, my attention for more than thirty years has been directed to this trade. The idea gives the impression of magnitude. Its progress has out-stripped anticipation, and I enter upon its discussion with great diffidence.

Between the Lakes and the Ohio and the Mississippi Rivers above their confluence, and west of the latter from its confluence with the Missouri River, is embraced a vast extent of country that for natural fertility is not surpassed by any territory of equal extent on the Globe. At the commencement of the present century this large territory was substantially an uncultivated wild,—and for the first quarter of this century, its settlement was mostly confined to the border of natural navigation.

Previous to the year 1825, the trade of the Lakes was trifling. The Erie Canal was opened this year, and the tide of emigration began to move with great force to the Lakes. Hitherto the commerce of the West had mostly taken the Mississippi River. For fifteen years the influx of emigration was such as to consume the greater part of the surplus productions that would otherwise have sought the Lakes as its outlet to an Atlantic market.

Emigration has continued and still proceeds with an increased ratio, but the fixed population has so increased, that it is steadily and rapidly gaining in its surplus production over all domestic demands. The Eastern bound tonnage of the Erie Canal derived from the Lakes in the year 1836, was 54,219 tons, and in the year 1853, it was, 1,213,690 tons, or twenty-two fold in 17 years, and the territory for the most part is not only in the infancy of settlement, but a large portion of its trade has taken the route of the Mississippi. Nearly all the natural navigation of rivers within its borders is connected with the Mississippi, and until artificial channels of navigation and railroads were opened, trade with the Lake route was restricted to such distances as could bear transportation to



its ports, over common roads, and these on the rich soil of the West, were very inferior of their kind.

The advantages of the Lake route soon drew the attention of the enterprising settlers at the West to the necessity of better means of transport from the interior. Ohio constructed two canals; Pennsylvania one, and Indiana one, all connecting the Ohio River with Lake Erie. The Indiana Canal has but recently been completed. Illinois has constituted a canal from Chicago, at the head of Lake Michigan, to the head of navigation on the Illinois River. These canals are more or less subject to a deficient supply of water, an evil that will no doubt be corrected, and with other improvements will make them more valuable means of transport than they have hitherto been, and greatly strengthen the trade of the Lakes.

The railroad improvement has come in, and will prove a vast auxiliary to the Lake trade. It is eminently adapted to produce great influence on the commerce of the West. Their great facilities for light traffic, especially in passengers, and the favourable formation of the country for their construction, permits them to be made and supported, where a canal would be impracticable for want of water, or where, if made, the heavy trade to which it is adapted would not be sufficient for its support. Four years since, the only railroad connecting the waters of the Lakes with those of the Mississippi, were two in Ohio, connecting Cincinnati with Sandusky and Cleveland on Lake Erie. The Galena railroad was commenced at Chicago, and had extended about 40 miles. There are now three railroads that connect Chicago on Lake Michigan with the Missouri. One at Galena, one at Rock Island and one at Alton, near the mouth of the Missouri. Other railroads are made and in progress that will more or less affect the course of Western trade. Their progress within the last four years has been unparalleled, and though now checked by the stringency of monetary affairs, they will be carried forward with little delay to meet the legitimate wants of a growing commerce. By an inspection of the Railway Map, it will be seen, the roads generally point to the Lake Ports, and their promoters look to the Lake trade, as their main reliance for traffic.

The effect of canals and railroads is to open greater facilities for intercommunication, extend the settlement of the country from the banks of navigable streams, and cause it to spread over the whole surface, causing thereby a general increase of trade. This will greatly amplify the volume from that portion which has heretofore sent its trade to the Lakes, while it will extend its area to sections heretofore tributary to other routes. The Rock Island railroad was the first to connect the Lakes with the Mississippi. It was opened in February, 1854, and has had a large freight trade from that river. In the fall of 1853, I made a journey from the Mississippi at Rock Island West, 180 miles to *Ft. des Moines*. I found but few people on the route, but they were looking to the opening of railroads to Chicago as their course of trade. And it may be remarked, that the Western people generally for obvious reasons, prefer the Lake route.

It will be conceded that the City of New York is the principal centre of American commerce, and the products of the West that take the Mississippi route, have, to a large extent, to be carried to New York for a market. And as the Lake route has the advantage of more favourable climate, it must be preferred even with some increase in the expense of transport.

The Pork trade has heretofore been mostly confined to the river cities. The railroads will transfer the most of this to the Lake ports, and instead of Cincinnati and St. Louis being the great packing establishments, we must look for them at Milwaukee, Chicago, Toledo, and Cleveland, as the great centres of packing for Pork and Beef.

In his able report on the enlarged Erie Canal for 1853, W. J. McAlpine, Esq., then Chief Engineer of New York, shows that the trade of the Mississippi,



above the mouth of the Ohio, will be directed to the Lakes, and thus secured to the Erie Canal. It will doubtless fluctuate more or less from any line of demarcation that may be made, by circumstances common to commercial operations, and the nature of the avenues through which it moves. At times the Mississippi will be open and the Lakes closed by ice. Again the supply and wants of one section of country will at times produce more or less a change in the course of trade. But taking into view, cost of transport, climate and market, there can be no doubt the great mass of trade will follow the Lake route as indicated by Mr. McAlpine. The tendency is that way, and the progress of improvement in the mean of transport all more in that direction.

The diversion by routes that must cross the Alleghany range of Mountains, cannot materially affect the volume of Lake commerce.

The area of the territory tributary to the commerce of the Lakes, and lying east of the Missouri River, may be estimated at over 300,000 square miles, and that west of the Missouri at 250,000 square miles. The latter is yet a wild Prairie, and from its inland position will only be able to send the more valuable productions of Agriculture to an Atlantic market. But it has a fertile soil, and will be brought into cultivation, and must eventually contribute largely to swell the volume of the Western Lake commerce.

Of the 300,000 square miles east of the Missouri, not more than one-eighth is now occupied by settlement. With this sparse population, and its surplus production to a large extent drawn to supply its large ingress of new settlers, it furnished in 1853, an eastern bound tonnage for the Erie Canal as before observed, of 1,213,690 tons—and a western bound tonnage, via Erie Canal during the same time of 261,752 tons. In the progress of eastern bound trade, the tonnage on an average more than doubled, in each successive term of four years; for three terms from 1836, and from 1848 to 1853, a term of five years, the tonnage was doubled. At what rate it will proceed to increase hereafter, it is difficult to conjecture. The tide of emigration is now moving with increased volume,—improvements that will produce a rapid augmentation of this trade have just come into use, and others are in progress. The Erie Canal of New York will soon be enlarged, and by cheapening navigation from the Lakes to the City of New York, will increase the Lake trade, not merely by extending the area of its drainage, but by embracing a wider range of bulky or heavy articles, that will not now bear transportation. From the history of the past, and the prospects for the future, it is regarded safe to estimate, that the tonnage will be doubled in the next six years, and quadrupled in the next fifteen years. It will be seen that no special notice has been taken of the trade from the North side of the Lakes, nor of the trade that will come from the mineral sources in the Basin of Lake Superior. If this progress is realized, at the end of fifteen years the Eastern bound tonnage will be five millions of tons, and the Western bound over one million of tons, and the trade will not be more than half realized. If this trade as it may be expected to exist in fifteen years, was all to pass the Erie Canal, (the local trade of the Canal remaining as in 1853) the arrivals at tide water would be over three times larger than it was in 1853, or seven and a half millions of tons; and the total movement on this Canal would be 9 millions of tons per annum. And although enlarged as now contemplated, that channel would be found wanting in capacity, for the convenient accommodation of so vast a trade.

Fifteen years is not a long time to look forward to meet the growing wants of this trade, and especially when the evidences of its probable growth are so strongly indicated by its history, and the facts of its expanding power. Hitherto the most sanguine have not anticipated its progress.

In considering the subject thus far, no allusion has been made to the Lake tonnage that has been carried by Rail Roads from the Lakes, to and from tide water, though a portion has been borne by Rail Road, it can have no influence



on that portion of the tonnage carried by the Erie Canal, which is the basis of the reasoning adopted, unless it could be shown that the Rail Road tonnage will, in future, increase in its ratio on the Canal. Hitherto the Canal has been of comparatively small dimensions and crowded in its business, which will be materially improved in cost, and expedition of transport, when enlarged as contemplated. No such improvement can be expected on the Rail Roads, as it appears now generally conceded, that their freight charges have been too low to afford a remunerating profit; and therefore, while the Canal charges will be reduced, the Rail Road charges will be stationary or increased, and the basis of our reasoning is not likely to be disturbed. It would not be reasonable to assume, that no improvement could be expected in Rail Road transport. Experience will doubtless make some progress in reducing the cost, and indeed very considerable improvement (as above intimated) is necessary to enable them to maintain themselves on the rates of freight charges that have been hitherto established. But it is not believed there is reasonable ground to anticipate such improvement in the cost of freight charges on Rail Roads, as will be equal to the improvement in Canal charges, when the Erie Canal shall be enlarged to the plan now in progress of construction. I have thus far taken the Erie Canal in comparison with other means of transport for this trade, for the reason, as will hereafter appear, that this is the only channel that will be able to maintain material competition with the projected improvement.

The Rail Roads, however, have transported a considerable amount of freight from the Lakes to the Atlantic Cities, and many persons suppose they will in a great measure supersede Canals, and be the favorite mode of transportation. It is evident this conclusion has been reached, without consideration, especially when applied to channels of great trade. There are doubtless many situations of considerable importance, where a Rail Road would be a more profitable improvement than a Canal, as a means of intercourse. The Rail Road is of a great value for the transport of heavy freight, but is especially valuable for the transport of passengers, and for light, valuable, or perishable freight; and when the proportion of heavy freight is comparatively small, the Canal could not be supported, though the Rail Road may be quite prosperous. And so it happens that Rail Roads near and parallel to Canals, carry a considerable amount of freight. As for instance, the New York and Erie, and the New York Central Rail Roads may be regarded as specimens of this kind of competition. The New York Central is as favourable a road in lines and grades, as will often be found for so great a length, is near the Canal for its whole distance, and about one fifth shorter. There are articles of freight that can be transported on a Rail Road, namely, such as are of a perishable nature, as fresh provisions, vegetables, fruit, &c., and live stock, for which a Canal is either poorly or not at all adapted. Articles that are light and valuable, and can afford to pay an extra charge for the expedition of Rail Road transport, will give the Road the preference to the cheaper, but slower movement on the Canal. When the prices of bulky and staple Agricultural products rule high, and especially if the market be in an uncertain or feverish state, more or less may be expected to take the Rail Road, as during the past season, it is believed the Rail Roads from Lake Erie have carried more flour than in any season before. Again the Canals in this latitude are closed near five months by ice, during which time all freight that can afford to move at Rail Road prices will go forward, and with the present high prices for the staples of Agriculture, there will be a much larger transport by Rail Roads than usual. It must therefore be conceded, that Rail Roads will find a class of freight they can secure, and may do a substantial business notwithstanding the competition of Canals; and both means of transport may be quite successful, where there is a large traffic, in which each shall take its appropriate part.



In regard to the trade under consideration, it may be remarked, that the great mass is composed of bulky and heavy articles, of such general value, as materially feels the weight of transport charges, especially if the distance moved be great, and cannot under the general condition of the market afford to pay much additional, to save a few days of time in transit. In this we are not left to conjecture, as it appears from the report of Mr. McAlpine before referred to, that the proportion of tonnage on the Erie Canal, and on the New York Central Railroad for four years, from 1848 to 1852, was, as 32 on the Canal to 1 on the Railroad, and when applied to the more heavy articles the comparison was trebly more favourable for the Canal. This ratio has no doubt been for 1853 and 1854, more favourable for the Railroad, but not such as to disturb the main principle involved, namely, that the cheapness of transport will in general secure to the Canal, the great mass of heavy freights; and especially if the Canal be large, and of its kind, adapted to the most economical transport. It is doubted if there is a case, where Canal and Railroad transportation devoted to a general traffic, that affords a more favourable opportunity for comparing their relative merits, than that above taken, and as they are designed to provide for the particular trade under consideration, are most applicable to this investigation. It has been shown what the effect has been, with the Canal comparatively small and inconveniently crowded with business, and it may be inferred that the Railroad will have small chance of obtaining the heavy class of freights, when the Canal shall be enlarged as now proposed, by which the transport will be cheapened, and the capacity greatly enlarged. The saving in time by Railroads, over water conveyance is most important when appertaining to short routes, when, for long distances, as from Chicago to New York, the delay incident to transferring freight from one Railroad to another, on the average, would occupy so much time, that little if any thing would be gained over a propeller, that could run to and from those ports without breaking bulk.

The Railroads that cross the Alleghany range having respectively their Atlantic termini at New York, Philadelphia, Baltimore, and Richmond, can have but small influence on the heavy traffic that tends to the Lakes; and those on the shores of the Lakes, running parallel with Lake navigation, will be quite unable to compete with the Lake for the heavy class of freights, except so much as may be sent forward when Lake navigation is closed by ice. The amount of this will depend on the condition of the market, and can never make a serious impression on the quantity of Lake Trade.

The Northern New York Railroad, extending from Ogdensburgh on the St. Lawrence to Lake Champlain, has transported a larger proportion of heavy freight from the Lakes, than the roads before mentioned. This has arisen from the local circumstances of this road. It carries the agricultural products of the Western States to supply the district about Lake Champlain, and to a large extent the Northern portion of New England, that has no navigation (except very circuitous) to compete with it. This condition (as will be hereafter shown) will be materially changed when the proposed St. Lawrence and Champlain Canal shall be but in operation.

Railroads have a salutary influence on great channels of trade, from their superior capacity in transporting passengers, and for light and valuable goods, and such as from their perishable or peculiar nature require quick transport, and for so much of all kinds as the condition of market may demand, when navigation is arrested by ice, and in this way confers a benefit on the interest of parallel navigation, whether natural or artificial. And in view of the of the character of the navigation now considered, they may be regarded as beneficial, rather than injurious to its interests.

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*Second.—The competition the Canada improvement must experience for the western trade.*

To examine comparisons the routes should be defined ; but for the present the definite route for the proposed Canal will not be discussed, and it will be assumed, as the basis of comparison, that from the foot of Lake Ontario to Whitehall, the navigation will be, namely:

By Canal.....	69 miles.
By River and Lake.....	263 “
Total miles,....	332

Lake Champlain is taken as 120 miles:

The first object of competition that is presented, is the Northern New York and Ogdensburgh Railroad. By this Railroad the distance from Ogdensburgh on the St. Lawrence, to Rouse Point on Lake Champlain, is 118 miles. From Ogdensburgh to Rouse Point, via the St. Lawrence, and the proposed Canal is,

By River St. Lawrence and Sorel.....	103 miles.
By Canal.....	69 “
Total.....	172

The vessel will arrive at Ogdensburgh, and have nothing to impede its regular movement, via River and Canal, and for all freights that do not require great expedition, there can be no room to doubt the freight would proceed on to Rouse Point, even if unloaded at that place for a market on the Vermont Central Railroad. To put this question at rest, it may be well to state, that according to the report of the State Engineer for the State of New York for 1853, the actual cost of transporting a ton of freight from Ogdensburgh to Rouse Point on the railroad was  $11\frac{7}{10}$  mills per mile, equal to \$1.38c. per ton through. This allows no profit on Capital expended in construction. The cost of transportation by the River and Canal, allowing a liberal toll on the Canal, would not exceed two-thirds of the cost by Railroad. It is therefore evident the Canadian improvement would command the trade of Lake Champlain, except a comparatively small portion that would require rapid transit. This would make the proposed improvement the Channel, of trade between the Western Lakes, and the greater portion of the New England States, including Boston, and the eastern portion of Massachusetts. The Railroad extending east from Rouse Point, Burlington and Whitehall, with their numerous connections towards the Atlantic would distribute and collect the trade on Lake Champlain. From Whitehall the Railroad via Rutland is a less distance to Boston by ten miles, than the Railroad from Albany to Boston, and supposed to be a more favourable line to work. There is no doubt as will subsequently appear, that transportation from the Western Lakes via Canadian improvement, can reach Whitehall at cheaper rates than it can reach Albany, and consequently it will command the trade from Boston and increase that trade. There was transported from Ogdensburgh to Rouse Point in 1852, 97,395 tons of Western freight. The same year there was transported from Albany eastward to the state line of Massachusetts, on the Albany and Boston road about 120,000 tons. There is also a large amount of Western produce carried coastwise from Albany to New England ports, that would be diverted by the proposed improvement. In view of this, and the Railroad tonnage above mentioned, it may safely be estimated, that the opening of the proposed improvement would find a trade on Lake Champlain of 300,000 tons eastern bound, and 50,000 tons western bound per annum.



The Western bound would be increased by the iron trade of Lake Champlain in ore and manufactures of iron, probably 20,000 tons, making a total of western bound of 70,000 tons per annum, or a total annual tonnage of 370,000 tons. The rich iron mines on Lake Champlain and the extensive manufactories of the country between Lake Champlain and the Eastern sea-board, with the commercial importance of the city of Boston, their connection with and dependance on Western trade must steadily increase the trade, via Lake Champlain, and render it of great importance to the proposed improvement. The impulse that will be given to this trade by the recent commercial treaty between the United States and Canada, will further and greatly tend to swell its volume.

I now come to consider the sources of competition for the trade of the Western Lakes, that seeks an Atlantic market at the City of New York. This is the destination of the great volume of this trade, and it now finds its avenue through the Erie Canal. This channel of navigation it is known, is in progress of enlargement, and is expected to be completed in a few years; this will greatly increase its present capacity and cheapen the cost of transportation. It does not therefore appear that under existing circumstances, it is necessary to make any comparison with the Erie Canal in its present condition, and I therefore proceed to consider the competition that must be anticipated from it, when enlarged as now proposed.

In this enquiry it becomes necessary to consider at what point, Buffalo or Oswego, this trade will be taken on the Erie Canal. Buffalo has hitherto been the principal port for transshipment to the Erie Canal. But Oswego has for several years been gaining on Buffalo, in consequence it is believed, of the introduction of screw propeller steam vessels on the Lakes, giving greater certainty in the time of navigation. The completion of the enlargement of the Erie Canal will give improved facilities to Buffalo. On the other hand if the Welland Canal be enlarged so as to admit an easy canal navigation for the largest class of vessels, but adapted to the navigation of the upper Lakes, it is believed Oswego will regain all she may lose, by the enlargement of the Erie Canal. If the Welland Canal should not be enlarged, Oswego will probably lose on Buffalo, as the size of propellers adapted to the most economical transport on the upper Lakes, as found by more recent experience, cannot pass that Canal as it now is, as will be seen by the table A in Appendix. It is therefore assumed as necessary to the following comparison, that the Welland Canal will be enlarged, so as to pass Propellers of 600 to 700 tons burden. (It is understood the New York Canals both from Oswego and Buffalo, to Albany are to be equally enlarged.) Buffalo has no doubt controlled a large portion of the Lake trade by her market, which is by far more important for this trade, than any other west of New York. In view of the improvements that will probably benefit both Buffalo and Oswego, it is not to be expected their relative advantages will be very materially changed. Regarding the question of transport merely, Oswego will probably have some advantage over Buffalo, and therefore the object of comparison will be attained, by considering Oswego as the port at which freight will change between the Erie Canal boats and Lake vessels. We are therefore brought on even terms with the Lake trade, to the foot of Lake Ontario. From this point then, the competition must commence, for the trade destined to New York.

The introduction of steam Propellers, on the Lakes, renders it more important to open Canada, by which Lake vessels may proceed from one stretch of natural navigation to another. They carry their means of propulsion with them, and are ready to proceed either by Lake, River, or Canal without the aid of other power. No towing is required, and consequently no provision of steam or animal power is to be held in readiness for use when they enter Canal or River.

In examining the cost of transportation, the ordinary rates, that are supposed to afford a fair remuneration for the business, will be sought, and not the ranges



above and below the scale, that are effected by varying circumstances, not necessary to be followed in this enquiry nor will it be essential to examine the cost of many articles of freight. Flour is an important article of the Lake trade; it will afford a good basis of comparison, and will therefore be taken as sufficient for the purpose under consideration.

The rates for transporting flour by Propeller from Chicago to Buffalo is often twenty-five cents per barrel. This rate, in the opinion of very experienced navigators affords a fair compensation for the business; paying current expenses, and yielding a return for the capital invested in the vessel. The distance is (1100) eleven hundred miles. Calling in round numbers ten barrels to the ton, (equal to 2160 pounds,) the cost of transportation is 2.27 mills per ton per mile or a fraction under a quarter of a cent per ton per mile. If 30 cents per barrel be taken for this transportation, it may be regarded as a liberal basis for any comparison the case requires. At this rate the cost per ton per mile is 2.27 mills or nearly  $2\frac{3}{4}$  mills. The voyage is lengthened by passing on down the St. Lawrence and through Lake Champlain; no new expense of loading or unloading, or delay in port, and the prolonged voyage is an element to reduce the rate per mile. The current in the St. Lawrence will be in favour of the greatest tonnage, and with Canals at the rapids of the river, will not be more, and probably less hazardous than the great Lakes. Lake Champlain is narrow, and as safe for the class of vessels that will occupy this navigation as a Canal. It is therefore believed a safe estimate to continue the voyage from the foot of Lake Ontario to Whitehall at the rate of  $2\frac{3}{4}$  mills per ton per mile, through the natural navigation, including the insurance on the St. Lawrence and Champlain.

The cost of Canal transportation cannot be arrived at so satisfactorily, owing to the uncertainty of the rates of toll. According to the Report of the Auditor of the Canals of the State of New York, on tolls, trade and tonnage for 1853, the toll on flour was 6 mills per ton of 2000 lb. per mile for the years 1851-52 and 53, or 23 cents per barrel on flour from Buffalo to Albany. The average cost of transportation including toll, was for 1851, 49 cents, 1852, 53 cents, and for 1853 56 cents on a barrel of flour. The lowest rate of transportation was 43 cents per barrel in August, 1851, and the highest was 74 cents in October, 1853. The average for the three years is a fraction under 14 mills per ton per mile, and this is according to the rates reported by Mr. McAlpine, State Engineer for 1852. No lower rates have been reported than above quoted, and therefore 14 mills per ton per mile may be regarded as the cost of transportation, including toll, at the rate now established for flour on the Erie Canal.

The completion of the enlargement of the Erie Canal will reduce this cost. It has been seen the toll amounts to 6 mills per ton per mile, on the present Canal, and if ten barrels are taken for a ton, the toll is 6.48 nearly  $6\frac{1}{2}$  mills per ton per mile. Flour being counted at 216 lb. per barrel. The freight on the present Canal, exclusive of toll, is say (very nearly)  $7\frac{1}{2}$  mills per ton per mile, counting ten barrels to the ton. The increase of tonnage will induce most probably, a reduction of tolls, especially if competition is to be met. What this may be, it is impossible to conjecture. I have supposed it could not go so low as to reduce freight and toll on the enlarged Canal, below 8 mills per ton per mile. This would reduce the cost by Erie Canal between Buffalo and Albany of transporting a barrel of flour (as in 1853) from 56 cents to  $31\frac{1}{3}$  cents including toll. It is therefore assumed that 8 mills per ton per mile, will be a fair basis for comparison of Canal transportation by the enlarged Erie Canal.

If the enlarged Erie Canal will so reduce the cost of transport, being in sectional area about 3 to 1 of the old Canal, it may be proper to enquire how this will compare with the proposed Ship Canal, which is to be three times the size or area of the enlarged Erie Canal. No doubt the cost of transport will be in favour of the Ship Canal, but the cost of construction may be greater per mile



for the latter, provided the same facilities occur. I have not the means to investigate this question, but from what has been done, there is not much reason to suppose the Ship Canal will involve materially greater cost per mile than the Erie Canal when enlarged, if not, it would be reasonable in a comparison to place transportation at least one mill per ton per mile less on the Ship Canal than on the enlarged Erie, and still leave the same provision for tolls as the Erie Canal. The question of tolls, however, depends on the amount of tonnage secured. And for greater safety it is better to estimate the cost of Canal transport, including tolls, as equal in the two cases. In this there is doubtless a concession in favour of the enlarged Erie Canal, that may not, and probably will not be realized.

No. 1.	{	From the foot of Lake Ontario to Whitehall, natural navigation River and Lake.....	263 miles.
		Canal navigation, aggregate.....	69 "
	{		Cents.
		263 miles at $2\frac{3}{4}$ mills.....	72.30
		69 " at 8 " .....	55.2 \$1.27.5
		Oswego to the Hudson.....	209 "

(See Report of State Engineer for 1852, Page 140.)

No. 2.	{	Oswego to the Hudson by enlarged Canal 209 miles at 8 mills per mile.....	\$1.67.2
		Transshipment port charges and damage by handling to freight.....	20 \$1.87.2

From the above it appears the Ship Canal will have ample margin to command so much of the Lake trade as will supply the shores and the outlets eastward from Lake Champlain as has been before stated. The same principle of computation makes the cost from Ogdensburgh to Rouse Point  $83\frac{1}{2}$  cents per ton or  $8\frac{1}{2}$  cents per barrel on flour, while the Rail must have 13 cents, and this gives no interest on the cost of construction.

From the foot of Lake Ontario to the Hudson river; *The Champlain Canal as at present.*

No. 3.	{	263 miles natural navigation.	
		263 at $2\frac{3}{4}$ mills.....	72.3
		69 miles Ship Canal at 8 mills.....	55.2
		65 " Champlain Canal at 14 mills.....	91.0
		Transshipment at Whitehall, port charges, and damage by handling to freight, same as at Oswego.....	20 \$2.38.5

Difference in favour of the enlarged Erie Canal from Oswego, 51 cents per ton or say 5 cents per barrel on flour. This is less than the difference between the average rates in 1851 and 1853, and shows that in the more pressing seasons of business, it would be divided between the two routes.

From the foot of Lake Ontario to the Hudson river; *The Champlain Canal enlarged as the Erie.*

No. 3.	{	Charges to Whitehall same as No. 1 .....	\$1.27.5
		Transshipment as No. 1 .....	20
		65 miles enlarged Boat Canal at 8 mills.....	52 \$1.99.5

Difference in favour of Erie Canal,  $12\frac{3}{10}$  cents per ton, or  $1\frac{1}{4}$  cents per barrel on flour, shewing the routes to be close competitors, leaving the preference with the Erie Canal in a small degree.



From the foot of Lake Ontario to the Hudson river ; *The Champlain to be made a Ship Canal.*

No. 5.	{	Charges to Whitehall same as No. 1... ..	\$1.27.5
		Whitehall to Albany Ship Canal 65 miles at 8 mills 52	\$1.79.5

Difference in favour of Canadian and Champlain route 7.7 cents per ton, or nearly 1 cent per barrel on flour. Here again the routes would be close competitors, leaving the advantage in a moderate degree in favour of the Canadian.

It is proper to remark that the Hudson river in its present condition, from Troy to a point about 20 miles below, is not a sufficient navigation to accommodate vessels of the draught of water that is intended for the proposed Ship Canal, and will require to be improved. Such improvement has long been contemplated, and some efforts have been made to secure the object, but so far, not much, if any improvement has been accomplished. If such work were effectively done, it would be highly beneficial to the vast trade that passes this portion of the river, and especially so to the commercial interests of the Cities of Troy and Albany. Tide water now reaches Troy, and such improvement as would fully provide for the navigation of vessels from the upper Lakes, is believed to be quite practicable, and no doubt will eventually be made. From a point some 12 or 14 miles below Albany the navigation of the Hudson is, in the highest degree, adapted to the navigation of even much larger vessels than proposed.

From the preceding it appears:—

1st. If the Champlain Canal is not enlarged, which is the most unfavourable view, the difference against the Canadian improvement will be five cents per barrel on flour to Albany.

2nd. With the Champlain Canal enlarged as the Erie, the difference against the Canadian improvement will be  $1\frac{1}{4}$  cents per barrel on flour to Albany.

3rd. The Champlain made a ship canal, avoiding all transhipment, the difference is in favour of the Canadian improvement, nearly one cent per barrel on flour.

To carry out the calculation on the premises above stated, the cost of transporting a barrel of flour from Chicago to the City of New York, (all the canals being made ship canals) would be 61 cents. And when the proposed improvements are completed and in established operation it will probably be done for 55, and perhaps for 50 cents, and no transhipment.

The distance by natural navigation.....	1758 miles.
“ Artificial.....	167 “

Total distance..... 1925

The voyage could be made by Propeller from Chicago to New York, in 13 to 15 days. The Canadian route would save about the time lost by the delay incident to transhipment at Oswego or Buffalo.

In the 2nd and 3rd comparisons the two routes would be so near equal, that an active competition could be maintained for the New York trade.

In the 1st comparison for the trade to New York, the Canadian route would be able to compete at those seasons, when freight should rule high, overcoming the small difference against it ; and at such times secure a fair share of this trade. It will be observed that, in the foregoing comparisons, no allowance has been made for superior and consequently more economical transportation by ship canal of three times the size, with locks adapted to vessels of 600 tons instead of 200 tons. In regard to tolls they will probably be alike, and have been so considered.

Thus far the subject has been considered without reference to the influence of pressure on the enlarged Erie Canal, that the rapidly increasing Lake trade is sure to produce ; and which will necessarily increase the charges of transport. But it may



be expected that such increase will lead to a reduction of tolls, if the State of New York considers it her interest to retain as far as possible, the trade on this Canal. The reduction of tolls on one route, would lead to a corresponding reduction on the other, and the comparison still holds good. By the time, however, these improvements are completed and in full operation, the Lake trade will have become so large, that no jealousy need be felt, as both routes will be remunerated with their respective shares, especially in view of its progressive expansion. (Some further remarks bearing on this point will be made in a subsequent part of this Report.)

*Third.* I now proceed to consider the 3rd Section of this Report, namely ;

*The dimensions of Canal and Locks best adapted to the Navigation.*

In regard to Locks, their dimensions should be such as will conveniently pass vessels adapted to the Navigation with which they connect. The first question, therefore, is, what is the size of vessels that will require accommodation. The ship canal and locks at the Sault Ste. Marie now in course of construction, and designed to connect Lake Huron with Lake Superior, has two lift locks that are 70 feet wide and 350 feet long. This canal is about  $\frac{3}{4}$  of a mile in length. It is here designed to provide for side wheel passenger steamers. There being but two locks and a very short canal, renders it very proper in this case to provide for such steamers. The Welland Canal Locks do not provide for side wheel steamers, nor is there any occasion for such vessels to pass through it. The length of Canal and the number locks, preclude any profitable or useful object in the transportation of passengers through such navigation.

Side wheel steamers as passenger boats pass down the St. Lawrence, and return by a portion of the St. Lawrence Canals. These boats do not require so long a lock as would be required by the largest class of Propellers that navigate the upper Lakes. But the side wheels require more width of locks than Propellers. Is it probable the proposed Canal, from the St. Lawrence to Lake Champlain, will require locks of such width as necessary for side wheel passenger boats? I think not. It is even doubtful if they can be supported between Ogdensburgh or Prescott and Montreal, after the Railroad now in progress of construction, along the bank of the St. Lawrence, is put in operation. Railroads will wholly supersede this class of boats, except where they have ample room, and the best character of natural navigation; and even in such case, the Railroad will materially reduce their importance and usefulness, where it is practicable, and there is sufficient business for its support. The Sault St. Marie has been mentioned, as a case where the shortness of the Canal, and the small lockage connecting very extensive Lake Navigation on either side, renders it highly important to provide for the large side wheel steamers that navigate those lakes. These circumstances are materially changed at the Welland Canal, where the length of the Canal and lockage is too great to admit the idea of passenger boats. Nor do I think there is any ground to suppose that steam passenger boats would find employment in conveying passengers between Lake Ontario and Lake Champlain. It may be said there would be a convenience in occasionally passing such steamers, to which it may be replied, that such occasions would not be of frequent occurrence, and would not repay the tax on freight vessels, that must be incommoded by the use of a larger lock than they require. The size of lock obviously should not be larger than sufficient for the convenient passage of the largest vessel it is intended to accommodate. It will pass such lock with the least delay. It is, therefore, considered that freight and not passengers is the business that is to be provided for in the proposed improvement.

During the past year some attempts have been made to introduce side screws into vessels. But as far as I have been able to learn, this method for propelling freight vessels, has not been received with favour by experienced navigators, nor does it promise to supersede the steam wheel, which is more out of the way of the



cargo, and allows better storage. Should side screws be adopted to any considerable extent, a wider lock would be required than for the steam screw. So far as I have been able to obtain opinions on this point, there does not appear sufficient probability of such use of side screws, as to warrant the expense and the inconvenience to other vessels that must be incurred in providing for them: And the steam screw Propeller appears to be the vessel that should govern in determining the size of locks.

I have obtained a list of 48 Propellers with their principal dimensions, and many particulars which have been put in a tabular form, see Table A., herewith appended. Only (11) *eleven* of these Propellers can pass the Locks on the Welland Canal. Most of these Propellers are employed in the navigation of the upper Lakes. There are but two in the table under 300 tons burthen. The largest 850 tons. The greater portion range from a few tons below 400 to a few above 600. The greatest length is 242 feet, the "Iowa," and her actual tonnage is 720, draws  $11\frac{1}{2}$  feet loaded. The "Oriental," is 234 feet, actual tonnage 850, ( $2\frac{1}{2}$  feet more beam (draws loaded  $10\frac{1}{2}$  feet of water. The "Plymouth," is 225 feet in length, (loaded, draft not ascertained) and carries 700 tons. These vessels can only carry full cargoes when the Lakes are at their greatest height. There are times occurring almost every year when vessels with over  $9\frac{1}{2}$  feet draught of water, cannot pass the St. Clair flats. Consequently those of greater depth must load lighter than their capacity, or depend on lightening when they reach the flats, or have occasion to enter harbours of a similar depth of water. The two most important Lake ports for outward bound tonnage are Chicago and Toledo. The entrance into the harbour at Chicago is kept open by excavations, so that vessels drawing 10 feet of water can, for the greater portion of the season of navigation enter the harbour. Toledo is on the Maumee river, and 9 feet water is as much as can usually be depended on, though at times they can go in with  $10\frac{1}{2}$  feet. Detroit river affords better water, and vessels that can pass St. Clair flats easily make Detroit.

In the enquiries I have been able to make as to the draft of water that vessels could carry and make the harbours with safety on the upper Lakes, I have found considerable diversity of opinion among navigators. The range of opinion has been from  $8\frac{1}{2}$  to  $11\frac{1}{2}$  feet. It is admitted, however, by those that advocate  $11\frac{1}{2}$  feet, that lightening will be often necessary, and this is considered to injuriously affect the profit of, and cause delay in the voyage. It is an important fact, that the most usual time of high water, (not regarding those rises and falls that occur in a series of years) is in midsummer, and lowest at spring and autumn. The latter are the seasons of greatest pressure in freight. It is conceded generally that the largest vessels can only take full loads when the Lakes are most favourable, and then only to the ports having the greatest depth of water. So far as I have been able to ascertain, it appears the most prevalent opinion, that the larger class of Propellers, both in relation to length and draft of water, have not been so successful in the economy of transport as those of less dimensions. The greatest weight of opinion I have been able to obtain is, that a draft of 9 or  $9\frac{1}{2}$  feet is as much as can be profitably adopted for general use, and that 10 feet is the extreme draft that should in any case be adopted and only for ports of best water. In the opinion of several very experienced navigators, the Propeller "Portsmouth," in her main features, is the best pattern for general use and economy of transport; she is 175 feet long and draws  $9\frac{1}{2}$  feet water, cargo 5000 barrels of flour, some would add 5 feet, others 15 feet to her length. This last addition would make her 190 feet long; and with a small increase of beam would enable her to carry 6000 barrels. Objections are made to greater length, on account of the increase of weight that is required to give the requisite strength, on a vessel of so small depth as must be adopted for Lake navigation.



To all these it may be said, the increasing volume of Lake trade, will lead to improvement in harbours, to the deepening of St. Clair flats, and so essentially improving the depth of water, as to provide for a deeper vessel, and so far removing the objection to greater length. From what has been, it is hazardous to say what may not be done, in the improvement of navigation, where a large interest is involved; and what now appears the best size for economy of transport, may hereafter prove quite too small; except so far as circumstances may enable us to judge of the probability of improvements, there seems no way of reaching a satisfactory conclusion in regard to the apprehension of the future. The question therefore is, what reasonable prospect is there, that the Lake navigation will be essentially improved. So far as I am acquainted with the Lake harbours, I do not see a prospect of any great change being made in the depth of water. But something of improvement will probably be effected.

It is not advisable to make the dimensions of Locks greater than will be sufficient for the vessels to pass; as increase of size beyond what is required, causes unnecessary delay in filling and emptying, and in handling the gates, and will be so far prejudicial to the navigation.

Regarding the present condition of Lake navigation, as connected with this improvement, it is believed the most economical transport would be secured by providing for Propellers of 500 to 600 tons burthen, which would be secured by a lock 200 feet long, 36 feet wide, and deep enough to float a vessel drawing  $9\frac{1}{2}$  feet water. It is not probable any width of vessel will be required that may not pass a lock of 36 feet in width, so far as shewn in Appendix A (and that shews nearly if not all the Propellers on the upper Lakes.) There are but six out of 48, that could not pass the Locks on the St. Lawrence Canals; some others could not load full depth, but would generally pass with ten feet water, and this is more than they generally draw. Hence it appears that the Locks on the St. Lawrence are of sufficient dimensions to pass Lake vessels, regarded as best adapted to present Lake navigation. If it shall ever appear necessary to enlarge them, it will be time to consider the measure when the contingency shall occur.

For the accommodation of present navigation I am of opinion that Locks 200 feet long, with 10 feet depth of water, and 36 feet in width, will provide for Propellers adapted to make as economical a transportation as can be effected; In this I would recommend that the side walls of Locks be carried to a height that will admit one foot greater depth of water, whenever it may appear necessary to make such provision. No greater width than 36 feet is required, unless it is regarded necessary to provide for side wheel steamers, which does not appear probable, and if not necessary, should not be made wider, as it would be a disadvantage to what must be the great business of the navigation, namely, freight by sail or screw. If freight is to be the main business, as I do not doubt it will, side wheel steamers are not wanted; for it is now well established on the Upper Lakes, that Propellers are decidedly more economical, and side wheel steamers can only be maintained where a large share of their business is passengers. If it shall be considered advisable to provide for greater length of vessel, say thirty feet, it may be done for about four thousand dollars per Lock. This additional length may be made at a future day, when it shall appear necessary. It must however be kept in view, that it can never be done so well, or so conveniently, as at the original construction; and though I am persuaded, that 200 feet, or at most, 210 feet, will be sufficient to meet the wants of the navigation, there is a possibility that a greater length may be found expedient at a future day, in the event of such improvements as have been mentioned, and such impression would mar the idea of a completed work, and injure confidence in its provision for the ample accomplishment of its object. It must therefore be perceived there is a conflict on this point, leaving some doubt, and as the interest is large, it may be the wisest cause to adopt the most liberal views. And, while I have doubts as



to the necessity, I must confess, that in view of all the probabilities involved, I am disposed to recommend (230) two hundred and thirty feet as a suitable length for the Locks (the distance between the Lock Gates is of course intended as the length) and of sufficient depth for vessels drawing 10 feet of water.

There are but few Locks on the proposed Canal; but as this question is necessarily connected with the Canal and Locks that already exist, and which must be made to conform to what is required to render the navigation complete, it was necessary to examine the subject with much care.

It has been stated that the St. Lawrence Locks need not be disturbed at present; but the Welland Locks and Canal, (as intimated in your instructions to me) must be enlarged. This will be necessary, independent of the proposed St. Lawrence improvement, in order to enable the Welland to maintain a vigorous competition with the Erie Canal, when enlarged as now in progress. As before observed, the large class of Propellers recently brought into use on the upper Lakes, are formed to cheapen transport, and when to this is added the benefit of the enlarged Erie Canal, the Welland route in its present condition must become inferior, as a means of transport, to the Erie Canal route. The Welland therefore must be enlarged for the maintenance of its own trade.

*Canal.*—The depth of water in the Canal should be at least one foot greater than the Lock, and if the Lock is designed for vessels drawing 10 feet, the Canal should have 11 feet. The width of the Canal at the surface of the water should be  $3\frac{1}{2}$  times the width of Lock, as the minimum in ordinary deep cuttings, and increased to 4 and 5 times, when the situation admits it, within reasonable expense. The top water width is therefore taken as a near approximation at (124) one hundred and twenty-four feet in heavy cuttings, and the width at bottom 80 feet. This allows slopes of bank two horizontal to one of rise on each side. On the proposed route, the ground will admit favourably, for the greater portion of the length, a surface width of from 150 to 250 feet, which will greatly improve the navigation.

The Welland Canal, as well as the Locks, is too small for the convenient and economical navigation of vessels of the size that is to be provided for, and should be enlarged. Of the St. Lawrence Canals, the Cornwall 150 feet wide, and the Beauharnois 120 feet wide, with good lines of direction, and well adapted to the proposed navigation, especially the former. The Lachine Canal, though its width is technically the same as the Beauharnois, is not in general so large. To provide for a large trade in the Lachine Canals, it would be indispensable to enlarge it, or reduce the use of water, now drawn for hydraulic power. I take pleasure in speaking of the Cornwall and Beauharnois Canals, as fine specimens of this kind of improvement. The four short Canals in the Williamsburgh district are too small for the navigation proposed. I suppose, however, these Canals are not much used for descending navigation, as the natural channel of the river allows, especially Steam Vessels, to descend with safety the small rapids, and for their return these Canals are mostly wanted, and therefore an enlargement of them is of less importance, and may be dispensed with. On the whole it does not appear that the St. Lawrence Canals are in any material respect, deficient in capacity to provide for the class of navigation that is proposed, at least so far as now appears necessary, nor until provision shall be required for vessels of over 600 tons burthen.

#### *Fourth.—The Lumber and other Canadian Trade.*

By a statement furnished by Mr. Dawson, it appears the Lumber Trade of 1852, was in square timber and sawed deals, plank and boards, (including the District West of Toronto) reduced to board measure as follows:

Exported to the United States,.....	159,593,000
Brought to Quebec,.....	567,595,000

Total,..... 727,188,000



The above takes no account of lumber disposed of in other markets. At 600 feet board measure to the ton, there was of the kinds above mentioned

Brought to Quebec,.....	945,990 Tons.
Other articles, as masts, staves, oars, ties, knees, saw logs, shingles, and lathwood, approximating estimate as brought to Quebec,.....	30,000
Total.....	975,990

This is regarded by Mr. Dawson as an under estimate, from which I infer the actual quantity exceeded one million of tons.

The report on trade and navigation for 1853, made to the Canadian Government by Mr. Hincks, Inspector General, shows the value of imports from the United States to have been for that year 2,945,536 pounds currency. The recent commercial treaty may be expected to materially increase this trade. Especially that branch of it, that would be opened by the connection with Lake Champlain, and through it with the New England States. By reference to the tables in the report above referred to, it will be seen that trade from the United States, embraces to a great extent the class of articles, that gives the greatest tonnage for their value.

The most important benefit that the general trade of Canada will derive from the proposed improvement, will be in opening for a large part of it either a new market or greatly improved facilities of transport to those now existing for her products, and especially for the lumber that now descends the St. Lawrence and finds its principle market at Quebec; a portion of this trade now finds its way to New York. If such improvement in its transport can be effected as will reduce the cost to Troy and Albany to nearly the same it is to Quebec, a choice of market will be presented of great value to this branch of trade. From what I have been able to learn, it appears the market at New York generally ranges higher than at Quebec, and if the New York Market was so opened as to take one half of the lumber that now goes to Quebec, no doubt a very material improvement would be made in its market value. In 1853 over (1,340,000), one million three hundred and forty thousand tons of lumber arrived at Albany and Troy from the Canals, or near 50 per cent. more than was received at Quebec. Large quantities of lumber is received at New York from the State of Maine, which is brought coastwise. This is mentioned to show that it is a large market for lumber. The sources of this lumber within the State of New York are not of that extensive character, especially for pine, that are found in Canada. Of the lumber of 1853, by Canals, about 550,000 tons were from other States and Canada; 220,000 tons was from Lake Erie, a source that will be materially interfered with by the demand that is rapidly growing up in the Western States where very little pine is found. Chicago has become within a few years, an important lumber market, and at all the principal ports on the upper Lakes large quantities of lumber find a ready sale; and the time must soon arrive when very little pine from the upper Lakes will go east of Lake Erie for a market. As before observed the pine districts in the State of New York that are available to the New York market are not extensive. They are rapidly being reduced by export to tide water, and by consumption in the interior. These circumstances are mentioned as indicating the probability of an improved price for lumber in the New York market, which must be of great importance to the lumber trade of the St. Lawrence and its tributaries.

It appears from Mr. Dawson's statement, that from the districts east and west of Toronto, there was sent to the United States in 1852 near 300,000 tons of lumber. The proposed improvement would doubtless divert a large portion of this lumber by the St. Lawrence and Champlain route, even with the Champlain



Canal of New York, as at present, and if that Canal be enlarged as heretofore suggested, nearly the whole would follow this channel.

Some portion of the lumber of the St. Lawrence, as before observed, now finds its way to New York by way of the Chambly River and Canal. This passes down the St. Lawrence and Ottawa Rivers to Sorel, from whence it proceeds up the Chambly to St. John's, which we may for the present consider the foot of Lake Champlain.

*Fifth.—The question of Tonnage and Revenue.*

It has been stated the western trade that passed the Erie Canal in 1853 amounted to nearly one and a half millions of tons including that in both directions. It is proper here to remark that it is supposed (returns not yet made public,) the tonnage of 1854 has been somewhat less than that of 1853. It has occasionally happened, as appears from the history of this trade, that one year has fallen below the amount of its predecessors, but this has not affected the general result, as for a series of years (not less than five,) it has shown its onward progress, and steadily increased its volume.

In the comparisons of routes the present Erie Canal has been left out. The enlargement of that Canal is now in progress, and expected to be completed in three years. To enlarge the Welland Canal, and construct the projected St. Lawrence and Champlain Canal will probably require nearly the same time, and therefore it must be expected to open for use with the Erie Canal enlarged, and no practical benefit can be expected from a comparison in its present condition, though the view would show favourably for the Canada route.

Assuming that both routes will be completed in three years, it must be expected that that portion or class of Lake trade will have reached by that time at least two and a half millions of tons per annum, including both directions. And in view of the influence that must be produced on that trade by the opening of the Erie Canal, and the completion of the Canada route as proposed, thereby reducing transportation between Chicago and New York to about two-thirds of the present rate, it appears reasonable to estimate the Lake trade for the second year of their operation at three millions of tons. Perhaps one year may not be sufficient to fully develop the new route, and provide suitable vessels to meet its requirements, but two, it is believed, will realize this expectation, and is sufficient for such estimates.

It will have been seen that one of the comparisons of routes has been made, on the basis that the Champlain Canal of New York remains without improvement, and in its present condition affords all the means that can be enjoyed in water transportation, between Whitehall and Albany or Troy. As this is a feature in the great idea of the proposed improvement that is not under the control of the Canadian Government, it appeared the dictate of caution to consider it in this view, as this exhibits the project in the least favourable light; and whatever can be realized under it, may be regarded as sure to be realized by the projected work.

Under this view the lumber trade cannot attain that benefit or extent that would be realized by opening the Champlain Canal on the size of a ship Canal, or to the size of the enlarged Erie Canal. If either method of enlargement of the Champlain were made, it is believed one-half of the Quebec lumber trade (or four hundred thousand tons per annum) would take that direction; but without such improvement one-half of this amount may I think be safely estimated on.

It has been shown that the trade of Lake Champlain, will be wholly enjoyed by the Canada route, and with the Railroad connections eastward from this Lake the total annual tonnage, including both directions, is estimated at 370,000 tons.



It is estimated as before shown, that by the time these improvements are in full operation, and their advantages fairly developed the trade of the Western Lakes will be annually (3,000,000) three million of tons including that in both directions. Under the circumstances now considered, the portion of this trade that seeks a market on the Hudson river, will have a preference of five cents per barrel on flour in favour of the enlarged Erie Canal. It is therefore obvious, the Canadian route eastward from Lake Ontario, can only participate in this trade at those seasons of pressure, when transportation rules above the ordinary rates. This usually occurs more or less in the spring and autumn, more especially the latter season. The rates on a barrel of flour ranged in 1851, from 43 cents to 60 cents, or difference of 17 cents. In 1852, from 47 cents to 68 cents, a difference of 19 cents; and in 1853, from 48 cents to 74 cents, a difference of 26 cents. It is therefore obvious that for a considerable portion of the season the Canada route would obtain fair remuneration, even with the disadvantage of the Champlain Canal of New-York in its present condition. Of the Champlain trade it must be borne in mind, that heretofore, say 100,000 tons have been carried by the Ogdensburgh Railroad, and form no part of that carried by the Erie Canal. Hence 270,000 tons will be the diversion from the Erie Canal route, to make up the Champlain trade. Leaving say 2,700,000 tons of Western trade bound to and from the Hudson, and which is to be competed for by the Canada route. Of this it is believed, from considerations before stated, the Canada route from Lake Ontario may obtain one-eighth, or say 300,000 tons.

The Western trade here considered forms no part of the existing trade of the St. Lawrence Canals, and will equally benefit those Canals as the projected St. Lawrence and Champlain Canal, and therefore the tolls that will accrue from its transit on both will be a result from the projected Canal. It is therefore proper to estimate the benefits on the whole line of Canal, through which the new trade will pass. Placing the toll on lumber which will only pass from the St. Lawrence to Lake Champlain on the projected Canal at one-fifth of a cent per foot, or at ten cents per ton of fifty feet, and on the Western trade at an average of 35 cents per ton, (about one-sixth less than the present rate of tolls on the Erie Canal) we have the basis of revenue from these sources. To these should be added the improved tonnage, that may be expected to result from the recent commercial treaty between Canada and the United States. That this will be considerable there can be no doubt; but as it is not susceptible of definite statement of tonnage, from any data at my command, it will be given at what I regard a cautious estimate.

Collecting the data before given we have as the probable business of the projected Canal,

250,000	Tons of lumber at 10 cents per ton.....	25,000
370,000	“ Lake Champlain trade at 35 cents per ton.....	129,500
300,000	“ Hudson River trade at 35 cents per ton.....	105,000
100,000	“ being improvement of general trade at 25 cents per ton.....	25,000

Result of comparison No. 1,..... \$284,500

With liberal allowances for repairs and maintenance, the next revenue may be considered (\$220,000) two hundred and twenty thousand dollars per annum. Though no improvement be made on the New York Champlain Canal, the trade of the Canada route will improve with the increase that must take place in the Western trade, at a greater ratio than has been taken for the above. The Erie Canal must annually become more crowded, and in a few years, this will be such as to increase the rate of transportation, and the delays of transit, that cannot fail to show a steady increase of trade by the Canada route; and may reasonably be expected within five years, from the time of its full operation to reach



one million of tons, instead of three hundred thousand, that with other trade will double the nett revenue above stated.

## 2ND. COMPARISON.

*Champlain Canal of New York enlarged to the size of the enlarged Erie Canal.*

If the Champlain be enlarged to the dimensions of the enlarged Erie Canal, it has been shown, that transportation by the Canada route would compare so nearly with that of the Erie Canal route, (the difference being only one and a quarter cents per barrel on flour) that the trade would be nearly the same; but let it be conceded there would be a difference in favour of the volume by the Erie Canal, it could not be great, and instead of one eighth, as taken in the first comparison, we may safely take  $\frac{1}{3}$  of the Hudson trade from the Lakes. This condition of the navigation would secure a lumber trade from the St. Lawrence of (500,000) five hundred thousand tons per annum, and directly and indirectly give a large increased value to this trade.

*Collecting our data we have the following as annual trade and revenue*

500,000	Tons of Lumber at 10 cents,	.....	\$50,000
370,000	do. Lake Champlain Trade at 35 cents per ton,	... ..	129,500
1,080,000	do. Hudson River Trade at 35 cents per ton,	.....	378,000
100,000	do. Improvement of General Trade at 25 cents per ton,		25,000

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2,050,000 Result of comparison No. 2, ..... \$582,500

Repairs and maintenance will be increased by business, and the nett revenue may be safely estimated at (\$485,000) four hundred and eighty-five thousand dollars.

## 3RD. COMPARISON.

*Champlain Canal of New York, enlarged to a Ship Canal.*

To enlarge the Champlain Canal of New York so as to admit Propellers of 500 to 600 tons, to proceed from Whitehall to New York, would be the appropriate consummation of the Canada route; and would enable it fully to divide the great Lake trade, seeking a market on the Hudson. By the comparison for this case, it appears the Canada route would afford slightly the cheapest transportation and requiring no transshipment, would be most expeditious. If one half of the Lake trade that seeks the Hudson now for its market, be assumed for the Canada route, it must be regarded quite safe.

*Collecting our data we have the annual trade and revenue as follows:*

500,000	Tons of Lumber, a 10 cents,	.....	\$50,000
370,000	do. Lake Champlain trade, a 35 cents per ton,		129,500
1,350,000	do. Hudson River trade, a 35 cents per ton,	.....	472,500
100,000	do. Improvement of general trade, a 25 cents		
	per ton, .....		25,000

---

2,320,000 Result of Comparison No. 3, .... \$677,000

The nett revenue may be estimated at (\$550,000) five hundred and fifty thousand dollars per annum, and to be eventually, at no very distant day, increased to more than double this sum.



*Collecting the several comparisons, the trade and revenue appear as follows :*

		Total Tons.	Gross Tolls.	Nett Revenue.
Comparison No. 1,	.....	1,020,000	...\$284,000	...\$220,000
do. " 2,	.....	2,050,000	...582,000	...485,000
do. " 3,	.....	2,320,000	...677,000	...550,000

As before observed, this amount of trade and revenue will be doubled in a very short time, after the improvement is brought into operation.

The great usefulness of the projected Canal, cannot be realized in its main features, without an improvement of the Champlain Canal of New York, and to make it complete this should be such as contemplated in the 3rd comparison above stated.

Will the State of New York provide such improvement? or, will jealousy for the revenue of the Erie Canal, induce her to refuse any co-operation, that may benefit the Canada route. At this time while that State is expending large sums for enlarging the Erie Canal, in the expectation, that when the Canal is enlarged, it will afford ample capacity for the Western trade, it is not probable any proposition of the above kind would be favourably received. On this subject I notice the remarks of your Honorable Board in their Report of 1853, before referred to: namely, the influence of vessels "at Whitehall, from the Western States, with cargoes of 500 tons" &c. I fully concur, that the influence they would produce, would be powerful on New York, to open a suitable channel through the Hudson. To the City of New York, this influence would come with great power; and if my views of the Western trade are to be realized, it will be apparent, by the time the above event can happen, that some collateral channel will soon be wanted to provide for the increasing volume of the trade; I have not doubted from the time the enlargement of the Erie Canal commenced, that its enlarged capacity would early find a full occupation and finally prove insufficient, and devoted at the time, all the influence I had, to induce the adoption of larger dimensions. But it was too early to obtain sufficient faith in such anticipations. History has, however, verified them, and nothing in the future can be more certain, than that the enlarged Canal, in less time from its completion, than it has been in construction, will be inadequate to fairly meet the wants of the increasing trade of the West; unless other provision be made, New York will again find this important channel too small for the accommodation of its trade. If the two routes were opened in complete order at the same time, they would excite a salutary competition, and give a *vast impulse to the Western trade*, while both would be well supported, and steadily grow together, in the enjoyment of its increasing volume. With these views there is no occasion of jealousy; for the time cannot be very distant, when they will have four millions five millions, and even six millions of tons annually to divide, and the end of increase is not yet. There is no speculation in this, if the ordinary course of things continue, and they produce their usual results. Nature has settled the question, and no other routes can divert this trade, provided they have their proper and obvious improvements. Its basis is such, that beyond question it will reach a magnitude unparalleled in the history of internal commerce.

The City of New York will obviously have a large interest in improving the New York Champlain Canal, and if the state should decline to make it, they may give the power to an incorporated Company to do the work, and it would be no great affair for the city to supply the means, which may be a good investment of money for individuals. No examination has been made to ascertain the cost of such work; but it is known the Champlain Canal was constructed at moderate cost. From what I have seen, and from information obtained from intelligent persons, who have been well acquainted with it, and the country through which it passes, there is believed to be no serious and not much expensive work required



for its enlargement ; and that six millions of dollars would be sufficient for its completion. To this should be added for improving the Hudson river for about 20 miles below Troy, probably from one to two millions. For the latter, tolls should be charged on all vessels the same as on the Canal, and whether they come from the Canal or elsewhere, this improvement of the Hudson river as before observed, would be a great benefit to Troy and Albany, allowing coasting vessels to come up with 10 feet water. It is supposed that eight millions of dollars would do the whole. Suppose the present business of the Champlain Canal will pay the interest on the charge the state may make for the existing Canal, and we have the lumber and other new business brought by the Canadian route to pay the interest on the above, which, at 7 per cent is \$560,000. This trade may be estimated at 2,000,000 tons per annum, within two years after the completion of the work, and will be subject to tolls at probably 5 mills per ton per mile, for 85 miles, including the Hudson river improvement. To this should be added the river tolls on other vessels from Albany and Troy, at least one million (and probably two) of tons, which together, make annual tolls (9) nine hundred and fifty thousand dollars, with a reasonably certainty of doubling in ten years. It may be regarded therefore, as a good field for individual enterprise.

Whether by the State of New York or by an incorporated Company, the suitable improvements of the New York Champlain Canal is a work that must eventually be done, and I therefore regard it only as a question of time.

*Sixth.—Description of the several routes for the proposed Canal from the St. Lawrence to Lake Champlain, with estimates of Cost.*

In accordance with the intimations I received from your Honorable Board, surveys have been made on four distinct routes: namely, one commencing at Sorel, the confluence of the Richelieu or Chambly River with the St. Lawrence; the second commencing at Longueuil, on the St. Lawrence, nearly opposite the city of Montreal. The third at Caughnawaga on the St. Lawrence; and the fourth at a point on the Beauharnois Canal,  $2\frac{1}{2}$  miles above the foot of Canal. All the routes terminating at the Town of St. John's, the foot of Lake navigation.

The country has been very thoroughly examined, and lines have been formed, that it is believed will very nearly indicate the proper ground for a final location, on either route, that may be adopted; and it may be said, they are all quite practicable, so far as engineering works are concerned.

The *first* or *Sorel route* follows the channel of the River Richelieu from Sorel to the lower termination of the Chambly Canal, a distance of about 46 miles. This has the improvement of the Lock and Dam at St. Ours. The channel is generally very direct in its course, and has a good depth of water. By the Dam at St. Ours, the water in the shallow places has been raised to a minimum of 7 feet in depth. To make it 10 or 11 feet it is only necessary to raise the Dam and Lock at St. Ours a corresponding height. From Chambly to St. Johns, about twelve miles enlargement and improvement of the Chambly Canal will complete the work. This, as will be seen is the least expensive route. The total length from Sorel to St. Johns is (58) fifty-eight miles.

The *second* or *Longueuil route* is (28.28) twenty-eight  $\frac{28}{100}$  miles in length. This line on the survey, proved longer than was anticipated from the general appearance of the country. It was found the long and deceptive (to the eye) undulations force the line into circuits, that inevitably increased its length. It strikes the Caughnawaga line, near Little Montreal River, from which point to St. Johns, it is common to the Caughnawaga line, on the Champlain level. Its entrance into the St. Lawrence at Longueuil, is not favorable for the construction and maintenance of wharves and piers for the accomodation of vessels. This is owing to the strong current near that place and the action of moving ice.



The *third* or *Caughnawaga route*. It is proper here to observe that two routes have been surveyed; one on the Champlain level, and one, by a more direct line, with a summit of  $37\frac{1}{2}$  feet above Lake Champlain. That by the Champlain summit is  $(34\frac{46}{100})$  thirty-four  $\frac{46}{100}$  miles in length, and by the direct line  $(25\frac{51}{100})$  twenty-five  $\frac{51}{100}$  miles in length. The Champlain level has two ascending locks from the St. Lawrence, and a guard lock at St. Johns. The latter will very frequently be used as a lift lock, owing to the changes in level caused by winds on Lake Champlain. The direct line will have eight locks, five ascending, and three descending to Lake Champlain; or six lift locks more than the Champlain level, and near, say nine miles less length of Canal. The direct line must be supplied with water from the St. Lawrence, and will require a feeder of  $(16\frac{19}{100})$  sixteen  $\frac{19}{100}$  miles in length. The feeder will enter the Canal at a point  $(4\frac{1}{10})$  four and  $\frac{1}{10}$  miles from its terminus at Caughnawaga. The entrance into the lock at Caughnawaga is about one a half miles above the Railroad and Ferry wharf. This is the nearest point at which a good entrance, with depth of water and quiet current could be obtained. The situation is very eligible for the wharves and piers that will be required; very safe, and by means of a small Island immediately above, very capacious accommodation may be made at moderate expense for the lumber trade, in changing from the river to the canal, as well as for vessels, in their transit between river and Canal.

The *Fourth*, or *Beauharnois Route*. This route commences on the Beauharnois Canal ( $2\frac{1}{2}$ ) two and a half miles above the foot of Canal, and makes a junction with the Caughnawaga direct line, at point  $(4\frac{1}{10})$  four and  $\frac{1}{10}$  miles from Caughnawaga. The distance from Beauharnois Canal to said junction, is  $(16\frac{19}{100})$  sixteen  $\frac{19}{100}$  miles. If made a feeder, this would be its length. If made a Canal, and regarded as a distinct line, then the line from the junction with Caughnawaga direct line, would be the same as the said direct line, to St. Johns; in other words, the two lines would be common from the junction to St. Johns. Regarded as one of the routes for the proposed Canal, the length from the commencement on the Beauharnois Canal to St. Johns, is  $(37\frac{66}{100})$  thirty-seven  $\frac{66}{100}$  miles, and will fall into the Champlain level at St. John's, by three locks, having an aggregate lockage  $37\frac{1}{2}$  feet. To compare this with Caughnawaga route, Champlain level, we have Canal navigation in the Beauharnois

Canal.....	2.50 miles.
Caughnawaga to St. Johns.....	34.46 "
<hr/>	
Total miles of Canal,.....	36.96 "
Or, Beauharnois route.....	37.66
Caughnawaga route, Champlain level.....	36.96 "
Difference in favour of Caughnawaga route.....	00.70 "
nearly $\frac{3}{4}$ of a mile.	

#### *In Lockage.*

Caughnawaga route or Beauharnois Canal.....	6	
Or, Caughnawaga Canal.....	2	8 Locks.
<hr/>		
Beauharnois route.....	3	"
<hr/>		
Difference in favour of Beauharnois.....	5	"

besides the Guard Lock, that would probably, half the time, make the difference six Locks.



It therefore appears the Caughnawaga route will have the advantage of  $\frac{3}{4}$  of a mile in distance, and the Beauharnois five (to six) locks, the advantage in lockage and save wholly the navigation of Lake St. Louis (14) fourteen miles. Caughnawaga route, direct line, we have Canal navigation, on Beauharnois

Canal .....	2.50 miles.	
Caughnawaga to St. Johns.....	25,57	
Total miles of Canal.....		28,07
Or Beauharnois route.....		37,66
Caughnawaga direct.....	28,07	
Difference in favour of Caughnawaga route.....		9,59

#### *In Lockage.*

Caughnawaga route, namely, on Beauharnois Canal,	6	
Caughnawaga Canal.....	8	
	—	14 Locks.
Beauharnois route.....	3	“
Difference in Locks in favour of Beauharnois route,.....		11

The Caughnawaga direct route will have the advantage of say ( $9\frac{1}{2}$ ) nine and a half miles in distance, and the Beauharnois route the advantage of (11) eleven locks, and as before stated avoid or save the navigation of Lake St. Louis.

With the size of Canal proposed walled on both sides as it will be designed, with a large proportion of Canal extra width which may be secured at reasonable extra cost, I consider the passage of one lock as being rather over an equivalent for one mile in length of Canal navigation. If, therefore, the Western trade was to be alone considered, there can be no doubt the Beauharnois route will most effectually secure it. But other considerations must not be overlooked in this question of route and they will be hereafter considered.

It has been suggested that a more favourable route could be found, by starting from the St. Lawrence at some point on Lake St. Francis, and by a higher level command the intervening country between that and Rouse Point, and wholly avoid the navigation of the river formed portion of Lake Champlain east of St. Johns or the greater portion of it. There has not been time to examine this route, so as to form any definite opinion of its merits. It will no doubt be longer than the Beauharnois route and have more length of Canal navigation with the same lockage. If it was supported there would be any material difficulty in making a good navigation from St. Johns to Rouse Point, this route would assume more importance. It is true some portion of the Channel between those points is not of sufficient depth of water ; but these are not of great extent, (most of the Channel being good both in depth and breadth) and from examination it is believed, may be dredged at moderate expense so as to render it fully adequate. The bottom appears to be of soft mud ; that must be reduced from one to three feet, and when once removed and subjected to an active steam navigation, will easily be kept a sufficient depth. Other considerations that will be shown hereafter induces me to believe there can be no great importance in prosecuting this subject further ; but if thought expedient, an instrumental examination may be made to more fully test its character.



Collecting our data.

The several routes from the St. Lawrence to St. Johns in length and locks, are as follow :

ROUTES—TABLE No. 1.

	Length in Miles.	No. of Locks.
First of Sorel River 46 canal 12 ... ..	58.	9. 1Ga.
Second or Longueuil.. ..	28.28	6. 1Ga.
Third or Caughnawaga, Champlain level... ..	34.46	2. 1Ga.
Do do Direct line. ... ..	25.57	8.
Fourth or Beauharnois ... ..	37.44	3.

The length of canal and river navigation on the several routes from a common starting point at the junction of the Beauharnois route with the Beauharnois Canal, will be as follows, (including the St. Lawrence Canals,) counting Guard Lock at St. Johns as one Lock.

ROUTES—TABLE No. 2.

	River Navigation in Miles.	St Lawrence Canals in miles.	St. Lawrence and Champlain Canal in miles.	Totals.	
				Miles of Canal.	No. of Locks.
First or Sorel ... ..	110	10.50	12.	22 50	21
Second or Longueuil ... ..	17	10.50	28.28	38.78	18
Third or Caughnawaga, Champlain level	14	2.50	34.46	36 96	9
Do do Direct line ... ..	14	2.50	25 57	28 07	14
Fourth or Beauharnois ... ..	..	...	37.36	37.66	3

One lock is considered rather more than an equivalent to one mile of canal, in the expense or time of navigation. The difference would be greater, if considered in regard to the expense of repairs and maintenance. Taking as a rule that they would be equal, and reducing the length of canals and locks on this basis, the comparison would stand as follows, comparing from the same point on the Beauharnois Canal as above.

ROUTES—TABLE No. 3.

	River Navigation, in Miles.	Total Canal, in Miles.	Total River and Canal, in Miles.	Total No. of Locks.	Equivalent in Locks and Canal, in Miles of Canal.
First, or Sorel .....	110	22.50	132.50	21	43.50
Second, or Longueuil.....	17	38.78	55.78	18	56.78
Third, or Caughnawaga, Champl. level	14	36.96	50 96	9	45.96
Third, or direct line. ....	14	28.07	42.07	14	42.07
Fourth, or Beauharnois.....	.....	37.66	37.66	3	40.66



The last column, it will be observed, is only a comparison of the artificial works, and does not consider the river navigation. It remains to make comparison of the cost of navigation, including river and canal. In the comparisons that have been instituted to show the relative cost between canal and river or lake transportation, one mile of the former has been considered equal to near three miles of the latter, but that included tolls. If tolls be left off it will be something less than two of river to one of canal; assuming for this comparison the ratio of two to one, the cost of navigation would be shown by including river, canal and locks, (exclusion of tolls,) and will be as follows:

ROUTES—TABLE No. 4.

	Total length of River and Canal in miles.	Total equivalent to miles of Canals.
First, or Sorel .....	132.50	98.50
Second, Longueuil .....	55.78	68.25
Third, Caughnawaga Champlain level .....	50.96	52.96
Do do Direct line .....	42.07	49.07
Fourth, Beauharnois .....	37.66	40.66

If tolls be added on the portion of canal on each route at 5 mills, or half a cent per ton per mile, it may be represented by adding to the last column in Table 4,  $\frac{1}{3}$  of the actual length of canal, which is the proportion of the cost of canal transportation allowed for toll; the comparison by miles of canal, will be as follows:

ROUTES—TABLE No. 5.

	Toll on Canals in Cents, per Ton.	Toll will increase. — Length of Canal in Miles.	Total Canal representing the last column in the above table and including Tolls.
First, Sorel .....	11.25	14.05	112.55
Second, Longueuil .....	19.39	24.20	92.45
Third, Caughnawaga, Champlain Level .....	18.48	23.10	76.06
Third, Caughnawaga, direct line .....	14.04	17.55	66.62
Fourth, Beauharnois .....	18.83	23.55	64.21

It appears from Table No. 4 that the cost of transportation, without regard to tolls, will be the cheapest on the Beauharnois Route, by nearly one-fifth. And from No. 5 including tolls, it will be near four per cent. cheaper than the most favorable of the other routes, or than the Caughnawaga Direct route for the Western trade.

It will have been perceived that the above includes a portion of the canals on the St. Lawrence, that are now in operation and can form no part in comparisons for cost of construction. I now proceed to state of estimated cost of construction for the projected St. Lawrence and Champlain Canal on the several routes.



*Estimated Cost of Construction.*

Routes.	Dollars.	Cts.
First, Sorel .....	2,016,080	
Second, Longueuil .....	3,473,360	
Third, Chambawaga, Champlain level .....	3,706,231	
Do do Direct line .....	3,287,240	
Do do Feeder made navigable .....	4,267,890	
Fourth, Beauharnois .....	3,369,400	

For details of the preceding estimates, I beg leave to refer to the accompanying report of E. H. Tracy, Esquire, who has conducted the surveys. The estimates have been made under my advice, and with much more care than usual in such examinations. They show larger cost of work than has heretofore been estimated. It is known that hasty preliminary estimates for such works, are usually insufficient to meet the cost of construction, and as this examination has been more full, ascertaining more completely the items of cost and the value of work to be done, it should be expected to be more accurate, and consequently more reliable. The aggregates have appeared to me large, but after review it has not appeared proper to reduce them. The canal is larger, and it is designed to be well executed, with side walls the whole length, and in every respect suitable for the best accommodation of the navigation. The canal, you will see, is larger, and the locks longer than provided for in former estimates. The plan of construction has aimed at stability and permanence, and furnish a work that will require comparatively small annual repairs. I feel confident they will be found a good approximation to the actual cost of constructing the work.

I feel great pleasure in saying that Mr. Tracy has conducted the surveys with energy and skill, which is neither more nor less than I expected; and that the assistants placed under his charge by your Honourable Board have cordially co-operated, discharging their respective duties with a highly commendable assiduity and intelligence.

*Seventh.—The advantage of the several routes proposed, for the trade that is to be accommodated.*

In the description there has been incidentally some reference to the respective advantages of the several routes.

*First or Sorel Route.*

So far as designed to be a Channel for that portion of the Lake trade that seeks a market on the Hudson river, this cannot be recommended as the proper one for the proposed Canal. It will not be the most favourable for the lumber trade of the Ottawa and the St. Lawrence above the mouth of the Ottawa. The cost of transportation from Sorel to St. Johns as I am informed, is one cent per cubic foot of timber. I am not able to say what the cost of transportation (by rafting) is, from the mouth of the Ottawa to Sorel. The distance is nearer 60 miles and a portion of the Rivers St. Lawrence and Ottawa between these points is difficult, and the cost including risk and the delay that must attend that route, I suppose would be not less than half a cent per foot, and make the total cost to St. Johns by this route, one and a half cents per cubic foot, or seventy-five cents per ton at 50 feet. If the same aggregate toll be charged (one-fifth of a cent per foot) as now charged on the Chambly, the transportation from Lake St. Louis to St. Johns' would be, not exceeding three-fifths of a cent per foot, or thirty cents



per ton of fifty feet, or a saving of nearly one cent per foot. It must be kept in mind that whatever cheapens the route to the Hudson river, not only enhance so much of what may take that route, but will also enhance the value of that which goes to Quebec, and viewed in all its bearing the apparently small sum of one cent per foot, must be regarded as worth from a quarter to half a million of dollars per annum to this lumber trade. With these remarks I must leave the Sorel route as quite out of the question.

### *Second or Longueuil Route.*

The termination on the St. Lawrence is very unfavourable for the lumber trade. Whatever of it goes down the Ottawa to its junction with the St. Lawrence, would not (and could not in rafts) be brought up to the Canal at Longueuil. It must be brought down the Lachine rapids, and owing to the strong currents in the river opposite and above Longueuil, it would be difficult to stop the rafts at the terminus of the Canal, and if they should pass it they would probably go on down the St. Lawrence, rather than attempt to bring them back against so strong a current as prevails in this part of the river. It is not therefore believed the lumber trade of the Ottawa and St. Lawrence could derive much benefit from the Canal on this route.

The strong current in the river between the terminus of this route and Montreal would be unfavourable for vessels entering and leaving the Canal. For the Western trade destined for the Hudson, the Beauharnois route would be thirty per cent. including tolls, and forty per cent. without tolls, more favourable, and the Caughnawaga direct line, including tolls twenty-eight per cent. more favourable than the Longueuil route, and give the most favourable accommodation by the latter route to the lumber trade of the Ottawa and the St. Lawrence above the junction of the Ottawa in Lake St. Louis. The only circumstance in favour of this route is, that the trade would pass Montreal and might find a market in that City, and would so far improve its commercial interests. This it is desirable to secure, if it can be done consistent with the main objects of the enterprize. How far the Canadian Government may consider it proper to hazard this, for such incidental benefits as would result to Montreal, it is not my province to decide. The navigation is now open and free to Montreal, and whatever route may be adopted for the projected Canal, it is not supposed it will direct any trade from her, but rather in any event bring a large trade so near her door that she can secure from it all that her commercial position will enable her to command.

Montreal will have no privilege taken from her, and will have increased inducement to improve every natural advantage she possesses; this new channel of a great trade will be near and tend to promote every branch of industry, increasing the inducements to improve the vast hydraulic power in her vicinity, and thereby multiply the sources of her wealth.

Viewing the enterprize as in the main designed to improve the value of the St. Lawrence Canals, as well as the Welland, to enhance the value of the great lumber interest of the St. Lawrence and its tributaries, and to improve the facilities of commercial intercourse with the United States, I am constrained, (much as I should be gratified to second the wishes of Montreal,) to pass by the Longueuil route, as not the proper one, to secure the great object of the projected Canal.

In the conclusions to which I have arrived in regard to the first and second routes it has not appeared important to regard as material, the estimate of the cost in construction. Other considerations are too decided to permit the entering of this as a material element in the comparison.



*Third, or Caughnawaga Route, Champlain level.*

It appears this route has been more generally regarded than any other for the projected Canal. It enters the St. Lawrence near the foot of Lake St. Louis, where a smooth sheet of water allows good facilities for vessels to enter and leave the Canal. For the convenient and ample accomodation of the lumber trade in transit from the St. Lawrence to the Canal. By this route a large portion of the Chambly Canal would be enlarged, and render it easy to give the same character of navigation to the mouth of the Richelieu, should it hereafter appear that the trade with the Lower St. Lawrence would warrant it.

It appears from Route Table, No. 5, the cost of transport including tolls will be twelve per cent. more on this route than by the direct line from Caughnawaga, and about 16 per cent. more than by the Beauharnois route.

*Fourth, or Beauharnois route and direct route from Caughnawaga.*

These routes are very nearly equal in regard to the Western trade, the difference being nearly, say four per cent. in favor of the Beauharnois route, including toll. The toll, however, in this comparison is nearly five cents per ton more than on the Direct Caughnawaga route; and on two millions of tons, the revenue would be near one hundred thousand dollars per annum greater. This would provide for an extra expenditure of over one million of dollars. The Beauharnois route will not provide for the Ottawa lumber trade, nor well for the trade of the lower St. Lawrence that may seek Lake Champlain and the Hudson. The Caughnawaga terminus is clearly the best for this. Here the Ottawa lumber comes in well, and it would not be able to reach the Beauharnois Canal without too great expense. The trade of the lower St. Lawrence above referred to, would find via Montreal and the Lachine Canal, a convenient and cheap transit via Caughnawaga to Lake Champlain; and would be subject to delay and extra expense if required to go by the Beauharnois Canal, and thence to Lake Champlain, which would probably prevent this branch of trade from taking the proposed Canal at all.

It has been stated, the Beauharnois route makes a junction with the Caughnawaga Direct route, at a point ( $4\frac{1}{10}$ ) four and one-tenth miles from its terminus at Caughnawaga. If therefore the Feeder required for the Direct route, is made navigable, a practical union of the two routes would be effected, that would provide for the best accommodation of the several interests of trade above referred to. If a route can be found that will secure in the best manner, all the great objects of the enterprize, it is clearly the one we are in search of. The Caughnawaga, Champlain level does not secure this. It is about 12 per cent. less favorable for the trade that collects in Lake St. Louis, and near sixteen per cent. less favorable for the Western trade, that seeks the Hudson. No adequate benefit in my judgment, would be obtained to compensate for this loss, especially when it is considered, that the general question of competition with a rival route is such that all the attainable sources of advantage should be carefully secured in the route adopted. The direct Caughnawaga line, with the Feeder made navigable, will be more expensive than the Caughnawaga route on the Champlain level, and less expensive if the Feeder is merely to supply water for the Canal.

The estimates have been stated, but for convenience they are here repeated as follows:

Caughnawaga Route, Direct line .....	\$3,287,240
do do do Feeder made navigable....	4,267,890
do Champlain Level.....	3,706,230
Beauharnois route .....	3,369,400

It will have been observed that in the preceding comparisons, toll has been charged on all at the same rate per mile. Of course the longest line would pro-



duce the largest revenue, the tonnage remaining the same. The Caughnawaga route, Champlain level has nearly the same length of canal as the Beauharnois route, and consequently they produce nearly equal tolls. In this case the comparison of Route Table No. 5, very nearly represents their relative merits, except as to cost of construction. The Table 5 shows, that for economy of transportation, the latter route to be about (16) sixteen per cent. more favorable than the former, and the estimates show it to be more favorable in cost of construction by the difference (\$336,830) three hundred and thirty-six thousand, eight hundred and thirty dollars. As between these two routes, the Beauharnois route in its superiority for the Western trade, and in cost of construction, should be preferred to the Caughnawaga route, Champlain level. On this point there can be no doubt, but it does not provide for other items of trade as before observed.

The Caughnawaga direct route provides on the whole the best accommodation for the aggregate trade of either route, but being shorter it produces less revenue. If an aggregate toll instead of a rate per mile was instituted, the comparison would be less favourable for this route ; giving it an advantage of seven instead of twelve per cent over the Caughnawaga Champlain level, and instead of route four per cent it would be about seventeen per cent inferior to the Beauharnois route for the Western trade. In cost of construction the estimates show it to be more favourable than the Champlain level, by a difference of (\$418,990) four hundred and eighteen thousand nine hundred and ninety dollars.

The Caughnawaga direct route, with Beauharnois Feeder made navigable, is clearly the route, that will most fully provide for all the great sources of the trade, it is important to accommodate by the projected Canal. It will have been perceived that the cost of construction on this plan, will be greater than any other route exceeding that by,

The Champlain level.....	\$ 561,660
Direct route, with Feeder of supply.....	980,650

It has been observed, that if equal aggregate tolls be charged on each instead of a rate per mile, the superiority of the Beauharnois for the Western trade is seventeen per cent over the direct route from Caughnawaga, and if toll charged per mile, the revenue on the former will exceed that on the latter about one hundred thousand dollars per annum, on a trade of (2,000,000) two million tons, which would be an ample sum for interest on the extra cost and maintenance of work, this revenue to increase with the increase of trade. The direct Caughnawaga route with Beauharnois Feeder made navigable is the direct route, with the Beauharnois Junction Canal. If the latter be adopted then all the great interests of the trade it is designed to accommodate will be provided in the best manner. The portion of lines are shown on a liberal scale, by the map prepared by Mr. Tracy, and is herewith submitted. By this the relative locations will show in the leading geographical characteristics, the respective facilities of each. It will be seen that by this plan, the lumber trade and the trade of the lower St. Lawrence will be well provided for at Caughnawaga, and especially the former will have the best accommodation that can be secured ; while the Western trade will have the best provision for its economical transport that is attainable. It is proper to remark, that the comparisons of transportation and estimates of revenue have been based on the Caughnawaga Direct Route with Beauharnois Junction.

Keeping in view that the projected Canal will involve the interests of a long line of navigation, materially affecting the artificial portions, made, or to be made for its completion, and that in its trade it must in some important respects meet the influence of a rival route ; I have no hesitation in recommending the Caughnawaga direct route, with Beauharnois junction. as adapted to fulfil in the most eminent degree all the great objects of trade that are to be either secured or promoted by the work. In arriving at this conclusion, I trust the details that have been given will fully sustain the opinion to which I have arrived.



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*Concluding Remarks.*

The estimates have been made in decimal currency to avoid errors to which I would have been exposed in adopting a currency I am not accustomed to, and as it will be quite immaterial in comparisons, will not I apprehend be a source of material inconvenience to others.

In discussing the questions that have been presented in this Report, it has been the design to adhere to a cautious regard of their bearing, and guard against leading to any inducement for expenditure that would not be substantially realized; and at the same time to give due weight to the interest of the enterprise under consideration.

In regard to the Lake trade, it is believed very few who have given the subject careful attention, will regard it as over estimated. The competition for it by Railroad would generally have been regarded more formidable a year ago, than at the present time, although the circumstances of the past year have been peculiarly favorable for freight on railroads. It has, however, added a chapter to experience, which leads to correct conclusions, and in this going to show that in long voyages they cannot hold important competition with good navigation for heavy freights. If there remain any doubt on the public mind in relation to this question, the completion of the enlarged Erie Canal, and the opening of the Canada route between the Lakes and the Hudson, I am confident will completely dissipate it. In this no feeling adverse to Railroads is indulged; they have their appropriate field of usefulness and cannot be dispensed with.

The discussion of the question of competition with the enlarged Erie Canal, is believed to have been very guarded, leaving every consideration of a speculative character out of view. It was assumed that all of the Canals of the St. Lawrence would be used in both directions; which I suppose will not be the case for those in the Williamsburg District, where vessels descending will find a sufficient channel in the river, thereby saving time and expense. It has been suggested that improvements may be made so as to avoid, in descending, the other Canals. Possibly this may be done; but I should not like to encourage any expectation of benefit from this source. It would require much improvement of Channel, to navigate a Propeller of 600 tons, with reasonable safety through the rapids opposite the Cornwall and Beauharnois Canals. So far as I am informed on this point, no advantage can be promised to the route from this source, and therefore none has been anticipated. If it shall hereafter appear that my views have been formed on an inadequate knowledge of the facts, and vessels with heavy freight may make the navigation of the rapids with safety, it will be a boon to the route I have not anticipated.

In comparing transportation by Canals, no superiority has been assumed in the economy of the Canada Canals, over that by the enlarged Erie Canal, though the former is very nearly three times the sectional area of the latter. That the Canada route will derive advantage in this, can hardly be doubted. On the whole, I have come to the conclusion that the two routes when completed, will most probably hold such a competition, that they will essentially divide the Lake trade. The difference between them in the transportation expenses, will not be sufficient for either to control, or, monopolize so large a trade; and this I regard a safe basis in estimating the trade of the Canada route.

Considering the benefits that will accrue to Canals already made, I have shown that it is safe for the Canada Government, to construct the proposed Canal, even if the Champlain Canal of New York is not enlarged, when that Canal shall be enlarged, (as I believe must be done at no very distant day,) the revenue from the St. Lawrence and the St. Lawrence and Champlain Canal must be large. As another power must be depended on to enlarge the New York Champlain Canal, it has appeared the dictate of prudence to examine the prospect of



trade and revenue on the minimum basis, namely, that such co-operation should not be extended. From this it appears the tolls may be estimated, for the second year of operation, including toll on this trade for that portion of the St. Lawrence Canals through which it will pass, at (2 4,000) two hundred and eighty-four thousand dollars, or after allowing for repairs and maintenance (220,000) two hundred and twenty thousand dollars; and that there is good prospect that in five years the tolls will be double this sum, or say nett, (\$400,000) four hundred thousand dollars per annum; nearly half which may be carried to the credit of the St. Lawrence Canals after paying interest on the cost of the St. Lawrence and Champlain Canal. This may be regarded as a minimum result; and when to the ordinary Canal revenue, the general benefits of improved and extended commercial intercourse, is added, the inducement is highly worthy the enterprise of your Government, and can have no hesitation in recommending the early construction of the proposed Canal, from St. Lawrence to Lake Champlain, as a work eminently calculated to promote the interest of Canada.

It will be noticed, that I recommend less width of Lock, than on the Saint Lawrence Canals. This would not be very important if no other Locks were to be built than required for the proposed Canal. But I must regard this question as embracing the enlarged Locks on the Welland Canal. I have given my reasons in detail for the width I recommend, and your Honorable Board will judge if I have comprehended the subject. Being fully impressed with the idea that freight is to be the great trade of this Canal, and that Propellers *mainly*, with some sail vessels, will be the craft that will bear trade, it does not appear to me wise to subject this main business, inconvenience, expense, or delay, for the purpose of providing for a remote, uncertain, and, in my judgment, improbable use of side-wheel steamers. The screw is now used even for tug boats; it has come in subsequent to the side-wheel, and especially for freight, has fully established its superiority. If then, the width of Lock is sufficient and best for this class of vessels, the object is secured. The width has been presented, after much discussion with experienced navigators on the Upper Lakes, and, to my judgment, appears adequate. The Lock will be sufficient to pass with great ease and convenience, a Propeller of 600 tons, and if one foot in depth is added to the water, it will be capable of easy passage of vessels of 700 tons. The Lock, as proposed, corresponds with the Welland Lock as 83 is to 38, and with one foot additional depth of water, the comparison is as 91 to 38. In giving the capacity of vessels, I take that regarded to be of most convenient management and the best form of construction of the navigation, and the relative sizes show that the proposed Lock has  $2\frac{2}{10}$ , the capacity of the Welland Locks, and with one foot added to the depth nearly  $2\frac{1}{2}$  times. If, however, it should be regarded as probable, that some new developement may demand vessels requiring greater width, it may be adopted to meet such anticipation. For the present, I do not see the probable necessity.

I have cautiously guarded against overstating the advantages of the route recommended. In allowing two miles of river navigation to be one of Canal exclusive of tolls, I am sure it is more true as to time than expense of transport if, as in the comparison, locks are excluded, or which is the same made to add to the length of Canal, by allowing one mile of Canal for each Lock. It may be said a feeder of supply may be made in the first place and afterwards enlarged to a Canal. I cannot recommend this; it can never be so well done as at first, and it is moreover important to put this work into the most effective operation in the first instance, to secure not only its appropriate and direct benefit, but to influence the opening of the New York Champlain Canal at the earliest day.

The dimensions of Canal with side walls as proposed will make a good channel for the first class of vessels proposed. The form of the ground favourably admits of making a large portion (about two-thirds of the length) with a



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width ranging from 150 to 250 feet, and vessels may easily and cheaply be propelled through it, at the average rate of five miles per hour. The plan is suitable for the great purpose it is designed to serve, and when completed, I do not doubt, will be creditable to the Government, and fulfil the high purposes of usefulness that have been anticipated from its construction.

Let this entire enterprise be properly completed, and a Merchant at Chicago may draw his bill on New York, on a cargo of produce at thirty days, and depend with usual certainty on the arrival of the vessel, the sale and collection of proceeds in time to meet his draft.

Regarding the vast magnitude to which the Lake trade must reach, the extent and excellence of the navigation, this route presents an inland communication, that for *grandeur in outline, and commercial importance*, has no equal on the globe. The idea of a vessel of 500 tons or 700 tons loading at an inland port, and proceeding without breaking bulk, two thousand miles without meeting currents in either direction, to reach a port on the ocean can nowhere else be indulged. The promotion of the artificial portions of this navigation, will reflect honor on the intelligence and enterprise of the Canadian Government, giving new claims to that progress in civilization that is strongly marked in works designed to improve the social and commercial intercourse of mankind.

The instructions I had the honor to receive, embraced questions of great importance which have been treated in as much detail as appeared necessary. It has appeared important that these preliminary proceedings, should fully unfold the great characteristics of the enterprise and at the same time it should not be encumbered with unnecessary detail. It has been my purpose to present each question in such a manner as would show the basis of the opinions given, leaving others the means of judging, whether or not those opinions were well founded. And your Honourable Board will judge, if the duty has been performed with an intelligence that will be beneficial to the great enterprise that has been under consideration.

Respectfully submitted,

(Signed,)

JOHN B. JARVIS,  
Civil Engineer.

Montreal, 13th February, 1855.

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TABLE A.

Names of Boats.	Propellers.	Length in feet.	Breadth in feet and inches.	Depth in feet and inches.	Draught of Water.				Tonnage.			Number of Boilers.	Kind of Iron.	Waste amount of steam in boiler water, in cubic feet.	Maximum pressure in side of Boilers, lbs. per square inch.	Area of grate in square feet, half an inch less than surface of boiler.	Diameter of flue of steam pipes (inches).	Diameter of cylinder of pumps (inches).	Length of stroke of pump (inches).	Average number of strokes per minute.	Length of boiler in feet and inches.	Diameter of cylinder in inches.	Number of engines.	Average number of revolutions per minute.	Point at which steam is cut off.	Diameter of main funnel.	Diameter of screw.	Pitch of screw.	Number of blades.	Length of blades from root to tip.	Weight of coal per hour.	Pounds of coal per hour.	Remarks.		
					Fore.	Stem.	Main.	Mast.	Measurement.	Actual.	Cost.																								
Alleghany	...	178	25	10½	...	...	...	...	468½	...	...	1	1½	149	75	858	9	2½	4½	2½	42	53	3½	30½	1	55	½	9	11	17	8	2	2	...	Boiler constructed after low pressure form
Barnes	...	178	25	10½	...	...	...	...	283	...	...	2	large 1	382	60	1915	4	2-2	4½	4	13	40	3	28	2	40	9½ & 12	13	28	4	3½	...	2000	Similar to Barn Hill.	
Bay State	...	198	25½	11	...	...	...	...	355	...	\$32,300	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bismarck	...	200	29	12½	...	...	...	...	512½	530	...	1	1½	166	68	1115	6	2½	3½	2½	42	55	3½	25	1	55	½	12	13½	17	6	2½	...	Boiler constructed after low pressure form	
Bismarck	...	180	29	11	...	...	...	...	493½	...	...	1	1½	239	68	1389	5	3	0	2½	42	42	4	34	1	42	13	13	23	6	2	2	...	Do do do do	
Bismarck	...	180	29	11	...	...	...	...	420½	...	...	1	1½	97	70	714	2	2½	2½	2½	34	70	2½	18	2	17	8	8	11	4	1½	...	...	...	
Bismarck	...	202	29½	12	...	...	...	...	682½	...	...	1	1½	239	68	1389	5	3	0	2½	42	42	4	34	1	42	13	13	23	6	2	2	...	Do do do do	
Bismarck	...	180	29½	11½	...	...	...	...	420½	...	...	1	1½	97	714	...	2	2½	2½	2½	34	70	2½	18	2	17	8	8	11	4	1½	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	111½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	22½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck	...	174	34½	10½	...	...	...	...	542½	...	...	1	1½	...	75	...	7½	2½	4	2½	42	...	8½	28	1	...	½	...	...	...	...	...	...	...	
Bismarck&gt																																			







# RETURN

IN part to an Address from the Legislative Assembly, of the 8th instant, for Copies of Documents relative to the Survey and Improvement of the Rapids of the River St. Lawrence.

By Command,

G. ET. CARTIER,

Secretary.

Secretary's Office,

Quebec, 30th March, 1855.

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## REPORT

*Upon the Examination and Survey of the River St. Lawrence, from Prescott to the Head of the Lachine Canal, and certain experimental blasting operations made during the Summer of 1854.*

The undersigned have the honor to report that, in accordance with the instructions contained in the agreement of October 18, 1853, between them and the Honorable Commissioners of Public Works, they have examined and partly surveyed the River St. Lawrence, from Prescott to the Head of Lachine Canal, with a view of ascertaining, "1st., the character and extent of the obstructions which would have to be removed in order to procure a navigable channel throughout the whole of the Rapids of the St. Lawrence, from Prescott to the Head of Lachine Canal, such channel not to be less than two hundred feet in width, to have at no place, at low summer water, a less clear depth than twelve feet, and in the Rapids, subject to much swell, not less than thirteen feet;" "2nd., the cost at which such improvement could be carried out."

That they have fired fifty sub-marine charges of one hundred and twenty-five pounds of powder each, as an experiment in different parts of the Rapids, for the purpose of ascertaining whether M. Maillefert's new method of blasting rocks under water without drilling could advantageously be made use of for the contemplated improvement.

They are happy to say that both the surveying and the blasting operations have been entirely successful; that it is practicable to open a channel of sufficient width and depth for vessels drawing ten feet, by means of removing the obstructions; and finally, that this great improvement can be carried out for an outlay of not exceeding one hundred and eighty thousand pounds (£180,000.)

The obstructions which it will be necessary to remove are in the Galoppe Rapids, the North Channel of the Long Sault, and the Rapids between Lakes St. Louis and St. Francis, of which the latter are the most extensive.

Before proceeding to describe these obstructions, and to estimate the cost of their removal, the undersigned beg leave to submit some general remarks relative to, 1. Their surveying operations; 2. The maps which accompany this Report;



3. The required width and depth of channel ; 4. The low summer water ; 5. The experimental blasting operations ; and 6. The estimates of cost.

### 1. *Surveying operations.*

The examination of the Channel was made in parallel lines, soundings being taken in the usual manner, the Surveying Barge used on the occasion was provided with tubes through which measured poles could be passed to any depth and easily moved up and down ; a mode of operation which was also made use of for the purpose of ascertaining whether or not the Channel was obstructed ; whenever a doubtful spot was found a more close examination was at once resorted to, and when it was ascertained to be necessary a thorough survey of the locality was made. It is hardly necessary to remark that to make a Marine Survey it is required that a triangulation of the adjacent shore lines shall be made, and proper stations established from whence sights can be taken to the surveying vessel at the Galloppe Rapids and the North Channel of the Long Sault, the obstructions being concentrated in one spot, the necessary stations could easily be established on a measured base line on shore, and no triangulation was required. But between Lakes St. Francis and St. Louis the obstructions were found to be so numerous and extensive, that it became necessary to survey that whole portion of the river, and consequently to complete the triangulation made in 1852 by Mr. James Stewart, C. E., which embraced the Côteau and Cascades Rapids, their labors in this particular are apparent on the Maps accompanying this Report. The undersigned beg leave in this connection to acknowledge the accuracy with which Mr. Stewart's triangulation had been made throughout, and the utility of his Map in their survey. Having accomplished these preparatory operations which from the great number of Islands, the width of the river, and the difficulties of Communication, required considerable time and labor, they proceeded to the examination of the different Channels in the following manner : The mode of surveying by sounding lines between stations on shore, or to and from buoys could only be made use of where the current was not strong and had to be abandoned in the Rapids proper. Here the swell below the *Chutes*, and the current above make it impossible to move a vessel with any degree of accuracy, and even the mere crossing in a boat is generally impracticable. The only available mode of operation, and therefore the one adopted, consisted in anchoring Scows at convenient distances one from another across the current determining the position of them from the stations ashore, and then in dropping down life-boats on measured cables. Each life-boat was manned properly with a Captain at the helm, an experienced man to take the soundings with a measured iron or wooden pole, and an assistant to book them. For every one or two hundred feet which the boat descended, a flag was raised, and the position of the boat determined instrumentally, from at least two stations on shore, by assistant engineers. It can easily be conceived that labor of this character occupies much time because only one line of soundings can be taken from each anchorage, and because the moving of Scows across the current, with a view of placing them in position, is attended with great difficulty, and sometimes with danger. It was frequently impossible, by one day's hard work to obtain more than one single line of soundings, and more than one day was entirely lost, when a Scow dragged her anchor in consequence of the extraordinary swiftness of the current, for in such instances no other alternative was left but to give up the anchorage, and to run down through the Rapids ; and to return to the original position, it was necessary to pass up the Canal. Another great delay was found in hauling up the life-boat to the scow, from whence it had started ; a slow operation, which required the utmost exertion of the men. In certain places the water was so turbulent, and the current so swift, that it was not only difficult and dangerous to anchor



the scows, but even to board them with the boats when at anchor, was attended with danger. These difficulties became in certain localities insuperable, and recurrence had to be had to so called running lines, an operation which consisted in letting boats run in different directions through the Rapids taking soundings from them, and at proper intervals showing a flag to which sight could be taken simultaneously, and with at least two good instruments on shore. These lines of soundings were protracted in the usual way with a good boat well steered and manned. This last named mode of operation, was found to be practicable in even the worst places, and where the open boats could not live, the iron barge built for the purpose was used.

It was by employing alternately and, as circumstances would dictate, the different modes of operation above described, that the soundings were obtained, a portion of which only could be marked upon the maps which accompany this Report. The aggregate number of soundings, taken and recorded in the field books, amount to over 28,000. The maps accompanying this Report are :—

No. 1—Survey of a Portion of the Galoppe Rapids.

No. 2—Survey of a Portion of the North Channel of the Long Sault.

No. 3—Survey of a portion of the River St. Lawrence between Lake St. Francis and Pointe au Diable, including the Coteau Rapids.

No. 4—Survey of a portion of the River St. Lawrence between Pointe au Diable and Pointe au Moulin, including the Cedar Rapids.

No. 5—Survey of a portion of the River St. Lawrence between Pointe au Moulin and Lake St. Louis, including the Cascades Rapids.

## 2. *The width and depth of the Channel.*

The several new Channels projected on the maps, show the position and extent of the obstructions necessary to be removed in each of them, so that they may be navigable for vessels drawing ten feet.

In laying down these Channels, care was taken to avoid obstructions and sudden bends, as much as circumstances and the prevailing currents would admit; each of the Channels will, therefore, if sufficiently improved, become a navigable Channel, but only one of the number will hereafter be recommended for improvement. A Channel of 300 feet width would be quite ample for vessels drawing ten feet, and there may be instances in which a combination of favorable circumstances, such as straightness of Channel, inconsiderable extent of the obstructions between which it runs, facility of entrance and ease in keeping the Channel, would admit of a width of less than two hundred feet, and should it be deemed necessary, the undersigned would be prepared to point out the localities where such deviations may be admissible; it may be proper, however, to remark, in this place, that the estimates given in, are based on the assumed necessity of a 200 Channel throughout. With regard to the depth of Channel, they do not see any occasion to comment upon the data given by the Honorable Commissioners of Public Works, and their experience would lead them fully to subscribe to the conditions contained in their instructions, that it ought not to be less than twelve feet in any place; and not less than thirteen feet where there is a heavy swell. The undersigned have, therefore, in stating the depths, which, in their opinion, will be required in each locality, found no occasion to go beyond the limits assigned by their instructions. The depths which will be recommended in the following, have also been marked on the maps accompanying this Report, and the estimates of cost have been calculated accordingly.

## 3. *The Low Summer Water.*

The stage of water called Low Summer Water, or ordinary Summer level, had been found by Mr. James Stewart, to correspond with a benchmark established by



him on Pig Island, Coteau Rapids, when that benchmark was one foot out of water, which result was confirmed by the observations of the undersigned. Before the survey was actually commenced, eight different benchmarks were established in the lower Rapids. They were frequently examined during the Summer, and the variations in the stage of the water were always found to be simultaneous and nearly equal throughout the Rapids. Between the 2nd of June and 11th of November, the difference between the greatest rise and the greatest fall which occurred during that period, did not exceed one foot three inches. The rise and fall in Lake St. Francis was found to be about the double of the corresponding rise and fall in the Rapids proper; but the fluctuations in Lake St. Louis are more considerable than those in Lake St. Francis, and differ from them in their periods and extent; the River Ottawa exercising much influence upon the stage of water in the former Lake. At the lowest stage of water observed, Mr. Stewart's benchmark was found one foot and six inches out of water, and the river having been uncommonly low this fall, it may be surmised that extreme low water is six inches lower than the ordinary Summer level, i. e., low Summer water. The undersigned have therefore adopted Mr Stewart's bench for low summer water and have reduced their soundings to that datum.

#### 4. *The experimental Blasting operations.*

Fifty heavy Sub-Marine charges were fired in accordance with instructions in different parts of the Coteau Rapids on smooth solid rock, as well as on bars formed of boulders and stones, &c., and in very swift currents; they proved efficient everywhere; though not equally so, the accumulations of boulders and stones yielding more readily than the solid rock, which was a very hard limestone; however, after this experiment, there can be no doubt, but that Mr. Maillefert's new method of blasting rocks under water without drilling which was most successfully employed for the removal of dangerous sunken rocks in Hell-gate near New-York, can also advantageously be made use of for the contemplated improvement in the River St. Lawrence, and is in fact the only available mode of operation.

#### 5. *The estimates of Cost.*

It will easily be understood that estimates of cost for operations of the character contemplated cannot be entirely based upon the quantity and quality of material to be removed.

To open out a channel through the various Rapids will necessitate a considerable and valuable outfit a great portion of which will have to be renewed in the course of the operation. A large allowance must also be made for the dangers and difficulties with which the work will be attended, the interruptions caused by navigation, the delays from accidents, and the liberal salaries and wages for which only good engineers and hands can be persuaded to engaged in such a work. It must also be taken into consideration, that in order to leave no one spot with less depth than required, the excavation will generally have to be carried to a still greater depth than the one specified, owing to the peculiar character of this work which especially in turbulent waters will not admit of the same accuracy and regularity as are obtained in similar operations on dry land. It is by taking all these circumstances into consideration and by dividing the cost of outfit and contingent expenses between the different localities, that the undersigned have arrived at the estimates of cost. The undersigned will now proceed to submit the results obtained by their examination and survey and to estimate the cost of the contemplated improvement. Commencing the examination of the River St. Lawrence at Prescott and proceeding downward, the channel at present used by vessels of heavy draft, was found to be sufficiently wide and deep until passing through the Galoppe Rapids, soundings of 9 and 10 feet were struck in the chan-



nel. A survey was therefore made of these Rapids the results of which are laid down upon the annexed Map No. 1, of the two channels leading to the Galoppe Rapids; the Southern is used only by steamers of light draft, and was found to be too narrow and too crooked to be available for the navigation contemplated; the Northern, or Main channel, is now navigated in all seasons by vessels drawing 8 feet, but it will require some improvement to be made sufficiently wide and deep for vessels of ten feet draft; the principal obstruction is a bar of solid rock, which stretches across the river forming a *Chute*, and which is covered only with 9 and 10 feet of water in the channel. The obstructions above and below this bar consist of boulders and stones. The whole can be removed by means of blasting and raising the *débris*: No difficulty would appear to exist, but the operations will be subject to frequent interruptions caused by the passage of steam and other vessels. To make the proposed improved Northern channel 200 feet wide, and 13 feet deep throughout 4,666 cubic yards of solid rock and boulders will have to be removed; and the cost of this improvement is estimated at £11,232. Leaving the Galoppe Rapids, no obstructions were met with before approaching the South channel of the Long Sault which branches off from the Main River about six miles above Dickenson's Landing. This channel, which at present is navigated only by vessels of light draft, and by Steamboats with low guards, or such as are not considered strong enough to sustain the heavy swell in the North Channel, was found to be crooked, narrow, and obstructed by several bars. It would require a considerable outlay to widen and deepen it sufficiently, and it would still remain crooked. Another great objection to this Channel arises from the fact, that it is the only available route for rafts, which, when passing through it, block up the whole Channel, and leave no room for Steamboats to pass, and owing to the frequent bends of the Channel, it is impossible for the Steamboats to discover them, until they are in close proximity; having at the same time found the North Channel superior both in width and depth, it was not considered necessary to make a complete survey of the South Channel, which cannot be recommended for improvement, unless it should be contemplated to make vessels ascend through the Rapids by means of some auxiliary motive power, a project which cannot be discussed in this place, but for the realisation of which this channel would offer peculiar advantages. The North Channel, which is now navigated by vessels drawing 8 feet and more, is very turbulent, but sufficiently deep and wide throughout, except at the upper pitch or *Chute* where it is obstructed, as shown on the annexed map No. 2. This Chute is formed by a ledge of solid rock, stretching across the river, and in the present Steamboat channel, covered only with ten feet of water. Immediately below the pitch several very heavy boulders lying on a stony shoal, Burns's Shoal, form another dangerous obstruction, towards which the current sets, and which it is difficult even for Steamboats to avoid. The present channel is at this place both narrow and crooked, and will require to be straightened, widened and deepened, to make it perfectly navigable for vessels drawing ten feet. It is proposed to widen the channel across the bar, as traced upon the map, with a view of entirely avoiding Burns's Shoal, and the heavy boulders lying on it. By removing a portion of the upper bar, the direction of the current will be changed so as not to set against Burns's Shoal, and would then take the direction of the channel, the removal of the obstructions in the North Channel by means of blasting, is considered practicable, but will be connected with difficulty and danger, owing to the extreme swiftness of the current, and turbulence of the water, both at the upper pitch and below it. The quantity of solid rock and boulders which will have to be removed in order to make the North Channel of the Long Sault, 200 feet wide, and 13 feet deep, throughout, is estimated at 4,550 cubic yards and the cost of this improvement at £17,198. From the Long Sault and down to the foot of Lake St. Francis, the channel was



found to be sufficiently wide and deep throughout. From Lake St. Francis two channels lead to the Coteau Rapids, "the northern or present Steamboat channel runs as shown on the map, and is obstructed by two bars, one at the head, the other below the foot of Prisoners' Island. There is at ordinary summer water not more than 7 or  $7\frac{1}{2}$  feet of water in the channel on the upper bar, which is hardly sufficient for vessels drawing 6 feet, and not more than between 8 and  $8\frac{1}{2}$  feet on the lower bar; both these bars consist of boulders and stones, and can be removed by means of blasting, etc. The operations would be comparatively easy on the upper bar, but connected with considerable difficulty on the lower bar, where the velocity of the current is over 14 feet in a second, and the waters are very turbulent. The operations in this channel on the upper as well as on the lower bar will be subject to frequent interruptions by the passage of vessels, and it is to be feared to frequent accidents arising from collisions with rafts when driven out of their ordinary route by strong northerly winds; a depth of 12 feet is considered sufficient on the upper bar, but 13 feet will be required on the lower bar, in consideration of the heavy swell. The quantity of boulders and stones, which will have to be removed in this channel is estimated at 25,665 cubic yards and the cost of the improvements at £40,365. The Southern or lost channel is not now in use, but was nevertheless surveyed with a view of ascertaining, whether a better and less obstructed channel than the Northern or present Steamboat channel could not be found, and considerable pains were taken to make this survey as complete and reliable as possible. The Southern Channel was found to be obstructed at Juniper Island by a bar of solid rock, which at this place forms a *Chute*; and further below *Chute verte*, by several extensive bars formed by an accumulation of boulders and stones. It is considered practicable to open a channel through these bars by means of blasting, etc., and the operation would not be attended with much difficulty, but would require a considerable outlay. In consideration of the swell, the depth to be not less than 13 feet on the upper, and  $12\frac{1}{2}$  feet on the lower bars. The quantity of solid rock and boulders, which will have to be removed in this channel is estimated at 60,085 cubic yards, and the cost of the improvement at £78,285. A channel which branches off from the present Steamboat channel above Pig Island between Pig and Thorn Island, then along the South side of Pig Island, and again joins the Northern Channel below this spot and abreast of Prisoners' Island; it is now sometimes run by Steamers and other Vessels, when the water is very low, but it is crooked and too much obstructed to be taken into consideration for the improvements contemplated. The cost of improving the Southern Channel was estimated at £78,285; that of improving the Northern Channel at £40,365, which gives a difference of £37,920 in favor of the Northern Channel; it must be borne in mind at the same time, that the Northern Channel follows the natural flow of the current, and is easier of access from Lake St. Francis than the Southern Channel. The undersigned have therefore no hesitation in recommending the Northern Channel for improvement, the cost of which was estimated at £40,365. From Pointe au Diable downward a few inconsiderable obstructions were met with, before entering the Cedar Rapids, at the head of which a ledge of rock runs across the present Steamboat Channel, partly covered with boulders and forming an obstruction, which is commonly called *la Barrière*!! there is at ordinary summer water not more than  $9\frac{1}{2}$  feet of water in the Channel, where it crosses this bar between *la Barrière* and *Pointe au Moulin*, the Channel was found to be obstructed by a few heavy boulders as shown on the map. The Raft Channel was found to be too shallow and crooked to be taken into consideration, and the present Steamboat Channel is therefore recommended for improvement. The removal of *la Barrière* and other obstructions in this Channel is considered practicable, but will, owing to the violence of the current, the heavy swell, and the vicinity of the *Chute aux Bouleaux* be attended with considerable difficulty



and danger, and besides be subject to frequent interruptions by the passage of vessels. A depth of 13 feet will be required throughout. The quantity of solid rock and boulders which will have to be removed is estimated at 5,600 cubic yards, and the cost of the improvement at £12,500. After having passed the *Pointe au Moulin* the Northern or present Steamboat Channel was found to be much obstructed, and the existence of other Channels having been indicated in the Reports of Mr. T. C. Keefer and Captain Maxwell the undersigned applied themselves to discover them, in order to ascertain their position and availability and to satisfy themselves, if the requisite improvements could be attained there, at less expense. The obstructions in the Northern or present Steamboat Channel marked AAA, on the map, are, 1 An extensive shoal of solid rock partly covered with boulders; and commonly called Bocco Hayes' Shoal or *la Chainette*; there is at ordinary low water not more than between 6 and 7 feet of water in the Channel over this bar, which is considered the shallowest spot in the river, vessels drawing 6 feet frequently touch bottom here. The removal of this obstruction is considered practicable; a depth of 12 feet will be required. The quantity of solid rock and boulders to be removed in this Channel is estimated at 9,100 cubic yards and the cost of the improvement at £18,700. This obstruction can be avoided, or nearly so, by following the channel marked BBB on the map, which leads around the south side of Bocco Hayes Shoal, "and joins the northern channel, AAA, above Mary's Reef. The channel BBB is but little obstructed, and the quantity of boulder stones which would have to be removed from it, to make it 200 feet wide, and 12 feet deep, is estimated at 630 cubic yards, and the cost of the improvement at £1760.

2. The next obstruction in the channel AAA, is Mary's Reef, which consists of boulders and stones, and has a depth at ordinary low water of not more than between 8 and 9 feet; the improvement of this channel, which is perfectly practicable to a width of 200 feet and a depth of 12 feet, would require the removal of about 4,725 cubic yards, boulders and stones, and the cost of this improvement is estimated at £5,325. This obstruction can be entirely avoided by running a southern channel, which is marked CCC on the map, and which will hereafter be called "Middle Channel," if continued and improved across the bed of solid rock stretching from Buisson Point, as shown in the map. To run south of Mary's Reef and then again to join the channel AAA, would not in the opinion of the undersigned, be practicable, nor would any improvement be gained by it.

3. The third and most formidable obstruction in the channel AAA is formed by an extensive bed of solid rock, stretching from Buisson Point across the whole river; the shallowest and most prominent portions of this bed of rock bear the name of Dog Reef, "*la Balire*" and Split Rock, and it is between these dangerous obstructions that the present steamboat channel finds its way over a continuation of shoals consisting of solid stratified limestone, partly covered with boulders and stones. It is considered practicable to remove these obstructions, to the width (200 feet) and depth (13 feet) required; but the operation would be subject to frequent interruptions by the passage of vessels and rafts, and when accomplished still leave one of the greatest objections to this channel unremoved, which is the direction of the current setting across it, as shown on the map. The quantity of solid rock and boulders which would have to be removed in this channel, to make it 200 feet wide and 13 feet deep, is estimated at 36,633 cubic yards, and the cost of the improvement at £76,666, adding to this the estimated cost of improving Mary's Reef, £5,325 and the channel BB, £1,760, the total £83,751, represents the cost of improving the channel AAA from Point au Moulin to a point marked X on the map. The magnitude of the outlay required for this improvement, together with the unfavorable direction of the current in this channel made it appear very desirable that another and a better channel could be found susceptible of being improved for a smaller outlay. The portion of the river between the



Channel AAA and the North Shore being very shallow, and for various other reasons quite unavoidable, the undersigned made a careful examination of the portion of the River, South of that Channel, and succeeded in tracing two distinct Channels which are marked on the map DDD, Southern or Saw Log Channel, and CCC or middle Channel. The operation of tracing these Channels was attended with much labor and danger, several of the *Chutes* being very turbulent, and no pilot having been found sufficiently acquainted with this portion of the River to guide the exploration. The most Southern or "Saw Log Channel," so called from a large stick of timber which for years had laid bare at the place indicated on the Map, but was swept away by the ice in the spring of the present year, is apparently the same which had previously been traced by Mr. Thomas C. Keefer. It runs, as shown on the map for a distance of about 1600 feet over the shallow bed of rock and joins the Northern channel AAA in deep water, between Round Island and Bursons Point, this channel a portion of which in its present condition is not more than five feet deep and the lower part of which is obstructed by boulders, can, however, be made 200 feet wide and 13 feet deep, and being easy of access from above and following the Montreal flow of the current, would, when improved, become a good navigable channel. The quantity of solid rock and boulders to be removed in this channel, down to the point marked X on the map, is estimated at 50,750 cubic yards, and the cost of its improvement at 104,900; adding to this 1,760 which is the estimated cost of improving the channel BBB the total £106,660, represents the cost of improving the channel DDD from Point au Moulin to X. The middle channel CCC runs as shown on the map, for a distance of about 800 feet over the same shallow bed of rock as DDD, a little above which it joins the Northern channel and is like DDD in certain spots only five feet deep. It can be widened and deepened respectively to 200 and 13 feet and being easy of access from above and following the natural flow of the current will, when improved become a perfectly good and navigable channel; it is like DDD obstructed in the Upper part by solid rock, here and there covered with boulders, and in the lower part by boulders, which have been deposited there, after having been swept over the shallow and smooth bed of rock above. The quantity of solid rock and boulders to be removed in this channel is estimated at 36,632 cubic yards, and the cost of this improvement at £76,664, adding the estimated cost of improving the channel BBB 1,760 the total £78,424 represents the cost of improving the channel CCC from Point au Moulin down to X. The cost of improving the two other channels between the same points having been estimated for channel AAA at £83,751 and DDD at 106,660 there is a difference respectively of £5,327 and £28,236 in favor of the middle channel CCC, which is therefore recommended for improvement at the cost above estimated of £78,424.

The fourth and last obstruction in the Channel AAA is formed by an extensive bed of solid rock, stretching across the river between the southern shore and Cascade Islet. On this bed of rock several heavy boulders have been deposited, which now form a dangerous obstruction, covered only with 6 feet of water, and commonly called the "Hay Stack." This formidable obstruction divides the present steamboat channel into two branches, a southern and a northern, which, however, join again shortly below, and continue as one channel into the deep water of Lake St. Louis. The channel laid down upon the map is recommended for improvement, being the straightest and least obstructed that could be found. The improvement of this channel will require the removal of the Hay Stack and other boulders, and the excavation of the solid rock, to the width (200 feet) and depth (13 feet) required an operation which is considered practicable though difficult. The quantity of solid rock and boulders to be removed in the Hay Stack Channel is estimated at 9,333 cubic yards, and the cost of the improvement at £20,281; adding to this the estimate for the Channel CCC £78,424, the total £98,705 represents the cost of the proposed improvement between Pointe au Moulin and



Lake St. Louis. The channel through Lake St. Louis was found to be sufficiently wide and deep, the only doubtful spot being the Chateauguay Shoal, on which, however, no sounding of less than 13 feet could be obtained; considering that at the time this shoal was examined, the water was low (10 feet) as on the upper sill of the Lachine Canal, that the bottom was found to be soft, and the shoal itself of no very great extent, it could not, in the opinion of the undersigned, be considered an obstruction to the navigation of vessels drawing ten feet. In case it should undergo change and become troublesome, it can be deepened by dredging at a small expense. The entrance to the Lachine Canal was carefully examined and found to be obstructed by ledges of solid rock, covered, in some instances, with not more than  $7\frac{1}{2}$  or 8 feet of water. But having been informed that an extension of the Pier is contemplated, which will tend to give a greater depth over those obstructions, and change the direction of the channel, the undersigned have not at present made any estimate of the cost of improving this entrance to the Lachine Canal; they are, however, prepared to do so at any time it should be desired.

Recapitulation of the estimates of cost of procuring a navigable channel throughout the whole of the Rapids of the River St. Lawrence from Prescott to the head of the Lachine Canal, by removing the obstructions; that channel to be 200 feet wide and between 12 and 13 feet deep at low summer water.

1. Galoppe Rapids .....	£11,232
2. North Channel of the Long Sault .....	17,198
3. Coteau Rapids, (from Lake St. Francis to Pt. au Diable,) .....	40,365
4. Cedar Rapids, (from Pt. au Diable to Pt. au Moulin,) .....	12,500
5. Cascades Rapids, (from Pt. au Moulin to Lake St. Louis.) .....	98,705
Total .....	£180,000

It results from the examination made by the undersigned, and upon which they have the honor of reporting above.

1. That the River St. Lawrence in its present condition, may be considered navigable during low summer water, from Prescott to the foot of Lake St. Francis, for vessels drawing 8 feet, also through Lake St. Louis for vessels drawing 8 feet or even 10 feet; and between Lakes St. Francis and St. Louis, for vessels drawing 6 feet, and during the higher stages of water by vessels resp. of a somewhat heavier draft, however, not exceeding resp.  $8\frac{1}{2}$  and  $6\frac{1}{2}$  feet.

2. That to make it perfectly navigable throughout, from Prescott to the head of the Lachine Canal for vessels drawing ten feet, will require the removal of obstructions in the Galoppe Rapids, the North Channel of the Long Sault, the Coteau, Cedars, and Cascades Rapids.

3. That the practicability of removing those obstructions by means of submarine blasting &c., has been ascertained by actual experiment in different portions of the Coteau Rapids; and

4. That the cost of the whole improvement will not exceed £180,000.

In submitting the above Report and accompanying Maps, which are the result of nearly six months of uninterrupted labor on the River, the undersigned beg leave respectfully to remark, that in the pursuance of their work in the field as well as in framing their report they have been governed throughout by the desire of collecting and conveying as much information as possible, but at the same time of keeping strictly within the limits assigned by their instructions. That for this reason they have refrained from discussing in the present Report the importance of the



improvement contemplated, and the different plans for making the St. Lawrence navigable, which have been proposed by others ; that however, at the same time they have at no moment lost sight of the magnitude of the object in view, and the importance of the investigation, with which they have been entrusted, that they have spared no effort to make their Report correct and reliable, and shun no danger where, to obtain information, it was deemed necessary to encounter it. They beg leave also gratefully to acknowledge the ability and cheerfulness with which they have been sustained throughout by their different assistants whom even serious accidents could not dishearten, and in concluding, would express the hope that in judging of their labors, the Honorable the Commissioners of Public Works will be pleased to take into consideration the peculiar difficulties with which operations of this kind are necessarily attended.

The whole respectfully submitted.

(Signed,)  
“

B. MAILLEFERT, }  
W. RAASLOFF, } Engineers.

Coteau Landing,  
15th November, 1854.

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NEW YORK, 9th September, 1853.

DEAR SIR,—Your much esteemed favor of 5th instant was received yesterday. In answer to your request to us to state whether we agree to have our tender for the deepening of the channel of the St. Lawrence altered according to the wording of the advertisement, we beg to say that the discrepancy between our tender and the advertisement is entirely unintentional, and that we agree to have our tender read as follows : The undersigned hereby offer in width to have at no place at low summer water a less clear depth than 12 feet, and in those rapids subject to much swell not less than 13 feet, and of a depth sufficient, &c.

We have the honor to remain,  
Dear Sir,  
Your obedient servants,

MAILLEFERT & RAASLOFF,  
Sub Engineers.

Thomas A. Begly, Esq.,  
Secretary Department Public Works,  
Quebec, L. C.

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NEW YORK, 26th October, 1853.

GENTLEMEN,—May we ask the favor of an order from you to allow Mr. Wm. M<sup>r</sup> Millen, of Montreal, our agent for this special purpose, to select and bring to Montreal before the close of the navigation, such boats, scows, anchors and tackle belonging to the Department as will be necessary for the prosecution of our survey of the rapids of the St. Lawrence, agreeable to the terms of our agreement with the Department of the 18th instant. We are anxious to have these materials collected at Montreal before the close of navigation, for the reason that we have made arrangements to have the scows, &c., repaired, improved and fitted out during the coming winter, for the special use we intend to make of them, and with a view of having everything ready for operation as soon as the navigation opens next year.



You would very much oblige us by sending the order which we solicit of you, to our address at New York, that we may forward it to Mr. Millen with our instructions.

Very respectfully,  
Your obedient servants,

MALLEFERT & RAASLOFF,  
Sub Engineers, 64 and 66 Broadway,

To the Honorable the Commissioners of Public Works,  
Canada.

DEPARTMENT PUBLIC WORKS,  
QUEBEC, 20th May, 1854.

SIR,—Having found but very little of available material in the depots of the St. Lawrence Canals, the undersigned now respectfully beg to solicit to be furnished by the Department of Public Works, for use in their exploration of the rapids of the St. Lawrence, the following quantities of anchors, chains and ropes, to wit :

2 anchors, each of .....	8 cwts.
2 do do .....	6 "
400 fathoms of.....	$\frac{5}{8}$ chain.
200 do .....	$\frac{3}{8}$ Manilla rope.

All of which material is of such size and dimensions as to become useful on the Canals, after having been used in the operations of the undersigned. The undersigned should wish to have the above material delivered to them at the foot of Beauharnois Canal, through Mr. Booth, the Superintendent of that Canal. They further respectfully beg to be furnished with the following surveying instruments and copies of Reports for use in their operations.

One 8 inch Metal Sextant.

Circumferentor or Surveyor's Compass.

Pris Malic Compass.

2 feet Station Pointer.

Plain Meridian Compass without graduation in an oblong box,  $5\frac{1}{2}$  inches by 8 inches.

One copy of Mr. Stewart's map of the rapids, reduced to a scale of 6 chains to 1 inch.

Document No. 12,196	kept per Thomas C. Keefer,	August 23, 1850.
15,858 $\frac{1}{2}$	Thomas Maxwell,	Febry. 7, 1852.
16,184	do do	March 8, 1852.
16,244	Samuel Keefer,	March 29, 1852.
19,427	Thomas C. Keefer,	April 6, 1853.
19,814	Samuel Keefer,	May 25, 1853.

The undersigned should wish to have these instruments and copies sent to them at Montreal. They have now very near completed their preparations for the exploration of the rapids of the St. Lawrence, and expect to be able to commence operations as soon as they shall have been furnished with the above material and instruments.

We have the honor to remain, Sir,  
With sincere regards,  
Your most obedient servants,

MAILLEFERT & RAASLOFF.  
per W. RAASLOFF.

Thomas A. Begly, Esquire,  
Secretary.



## DEPARTMENT PUBLIC WORKS, QUEBEC.

MONTREAL, 5th May, 1854.

DEAR SIR,—The undersigned are now repairing a scow belonging to the Board of Public Works and lying at the head of Williamsburg Canal, and intend to have her brought down to the head of Lachine Canal in the course of next week; they therefore solicit from the Department an order to the effect to allow this scow to pass through the St. Lawrence Canals free from charge. They will, in the course of their operations towards exploring the Rapids, from time to time, have to bring their scows, barges and boats through the Canals, and beg to suggest that a general order or pass be granted by the Department to the effect that scows, barges and boats belonging to them, and used by them in the above mentioned operations, may hereafter, and during the whole of the present season, be considered as belonging to the Board of Public Works, and be allowed to pass through the St. Lawrence Canals free of charge.

We have the honor to remain, dear Sir,  
Your obedient servants,

MAILLEFERT &amp; RAASLOFF.

Thomas A. Begly, Esquire,  
Secretary.

P. S.—Address: St. Lawrence Hall, Montreal.

COTEAU LANDING, 5th June 1854.

SIR,—I beg respectfully to inform you that we commenced operations the 2nd instant, with the material at present in hand. Our outfit is not yet entirely completed, but will be so in a week or two, when the iron barge now building at Montreal shall have been received. The lateness of the season this year and the scarcity of labour have exercised their delaying influence upon our preparations as upon almost all the other works of public improvement; but we trust that with activity and energy we shall be able, at least in a measure, to make up for the time thus lost without any neglect of ours. The want of ropes will, however, soon be felt seriously; and having gone to a very considerable outlay (more than £1000) for the iron barge and for boats of different kinds, which were absolutely necessary, and of which none could be furnished by the Board, it would at once exhaust the amount allowed for the survey if we were also to purchase and furnish the considerable quantity of rope which will be wanted for carrying out the work without further delay and interruption, and I beg respectfully to express the hope that the Department will, in consideration of circumstances, grant us the rope for which we applied in our letter of 20th May last. There will necessarily be a great many expenses to be incurred during the operations as suggested by experience as well as by peculiar circumstances; and it appears to me very desirable that as great a portion as possible of the whole amount allowed should remain available for the operations proper, the pay of assistants and men, transportation of material and men from one point to another, purchase of powder and other material specially required and adapted for this novel and peculiar work. I have commenced, according to your suggestion, to place water marks in different parts of the rapids, and intend to run levels in all directions with a view of determining the slope of the surface of the water in



the river in and above the Rapids. This information will be valuable for the proper discussion of the different plans for the improvement which may be suggested hereafter.

I have the honor to remain, with high regard,  
Your most obedient servant,

W. RAASLOFF.

The Honorable Hamilton H. Killaly :  
Commissioner Public Works, Quebec.

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MONTREAL, 6th June, 1854.

SIR,—The undersigned beg respectfully to inform you that they have commenced operations in the Coteau Rapids, and that they expect to meet Mr. James Stewart here to day, and thereafter to go over the ground with him, and to receive information from him relative to the survey made by him. They are under these circumstances very much in need of the maps with which it is the intention of the department to furnish them, and therefore took the liberty to send you a telegraphic despatch expressing the wish that you would do them the favor, if possible, to forward such of the instruments and maps as may now be ready by the John Munn, the receipt of one map (copy,) and a sextant to-morrow, would in a measure enable the undersigned to proceed without delay with Mr. James Stewart to the field of operations and to verify as much as necessary the points determined by Mr. Stewart.

Very respectfully,  
Your most obedient servant,

MAILLEFERT & RAASLOFF.

Thos. A. Begly, Esquire,  
Secretary Department of Public Works,  
Quebec.

P. S.—Address : St Lawrence Hall.

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MONTREAL, 14th June, 1854.

SIR,—We have the honor to acknowledge receipt of your letters of the 7th and 10th instant, and of the copies of documents therein mentioned.

We find that we will require for our surveying operations besides the instruments mentioned in our former requisitions.

One Transit Instrument.

One Theodolite.

One Rochon's Micrometer Telescope, and beg respectfully to solicit that the Department would be pleased to furnish us with these instruments. We also beg respectfully to enquire whether we can expect to be furnished with the scow now at Flagg's Bay, which was the object of one of our former requisitions to the Department. We have written to Isaac Rose, Esquire, Superintendent of Williamsburgh Canals in relation to this subject, but have as yet received no answer from him.

We have the honor to remain,  
Your most obedient servants,

MAILLEFERT & RAASLOFF.

Thos. A. Begly, Esquire,  
Secretary Department of Public Works,  
Quebec.



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COTEAU LANDING, June 14th, 1854.

SIR,—Since I had the honor of addressing you my last letter we have been engaged in surveying the channels leading to the Coteau Rapids proper. Mr. Stewart's map covers but a portion of this ground and the greater part of his stations have been destroyed and cannot be found again; it was therefore necessary to start afresh from the basis measured by him and to triangulate the whole group of islands in and above these Rapids. This triangulation is in good progress and so are the soundings in the Southern channel. We find that channels which are generally considered to be deep and wide become doubtful from the very moment a width of 200 feet and a depth of at least 12 feet is contemplated; a mere examination would not suffice to remove these doubts entirely, and we have therefore determined to make a thorough survey of these Rapids and *the Channels leading to them* rather than to leave any thing uncertain and doubtful behind us; we were confirmed in this determination by the belief that it would meet with your approval; we have sufficient material on hand for our present operations and expect to have the iron barge ready by the time we shall have to survey the lower part of the Coteau Rapids. We are also well provided with life-boats anchors and chains, for future operations, but we will no doubt very soon have to regret the want of a sufficient quantity of rope.

The water is falling in the river and we are now not more than about one foot above ordinary summer level.

I have the honor to remain,  
With high regards  
Your most obedient servant,

W. RAASLOFF.

The Honorable Hamilton H. Killaly Esq.,  
Commissioner Public Works.

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MONTREAL, 4th June, 1854.

To the Honorable the Commissioners of Public Works, Quebec.

The undersigned have had occasion in their former communication to the Board, to mention the fact that but very little available material belonging to the Board having been furnished for use in their operations in the St. Lawrence, they had been compelled to go to a very considerable outlay for new and good material properly adapted for this service, and also that this outlay, together with the expenses incurred for repairs of material belonging to the Board, transportation thereof, and for the surveying operations proper would nearly exhaust the sum of £2,000 allowed for the survey, &c., of the Rapids. Having now completed their outfit or very nearly so, they respectfully solicit the Board to take off their hands the material hereafter mentioned, all of which it was absolutely necessary to have on hand, and without which the operations could not be carried out at all, namely: One iron barge 55 feet long (built at Montreal), three Francis' metallic life-boats of different sizes, from New York, one wooden scow, 36 feet long (built at Montreal), one wooden boat with sails, 32 feet long, from New York, two Calistans, one with divers pieces of machinery and appurtenances to the barge and boats, oars, blocks, life preservers and other objects of outfit. The outlay for this material, including freight and import duty will amount to £1293. Anticipating a favorable decision upon this request, we beg most respectfully to enclose the following vouchers for disbursements actually made for the above mentioned material, to wit:



Voucher No. 1 from Messrs. Glassford and Walker of Montreal, for disbursements made on our account to Messrs. Millen and Milne, likewise from Montreal, who have undertaken by contract to furnish the iron barge for £762 10s. Amount £506 13s. 10d. Voucher No. 2, from Francis' Metallic Life Boat Company, for two Life Boats and appurtenances \$343 62 c'ts, makes £85 18s. 1d. Voucher No. 3, from same, for one Life Boat and appurtenances \$181 70cts, makes £45 8s. 6d. Voucher No. 4, from Burr, Waterman, New York, for blocks \$35 50cts., makes £8 17s. 6d. Voucher No. 5, from Donmers' Nixon & Co., New York, for Patent Felt Mattresses, Life Preservers, &c., \$61, makes £15 5s. Voucher No. 6, from Mullins, Montreal, £10 12s. 3d. Voucher No. 7, Chamberlain Thompson, £17 2s. Voucher No. 8, Brewster and Mulholland, £9 16s. 6d. Total, £699 13s. 8d. ; and solicit most respectfully that the Secretary of the Department of Public Works might be authorized to refund us the amounts of the vouchers, viz: £699 13s. 8d., and also hereafter to receive from us vouchers for the balance of the material above specified, and to refund us the same to the amount of £593 6s. 4d., together, £1293.

We have the honor to remain,  
Your most obedient servants,

(Signed,)

MAILLEFERT & RAASLOFF.

MONTREAL, 27th June, 1854.

Having now surveyed the greater part of the different channels leading to the Coteau Rapids proper, and having also examined several portions of these and of the Cascades Rapids, the undersigned consider themselves well acquainted they will have to operate, and beg leave, most respectfully, to submit the following suggestions and remarks relative to the manner in which the operation, in which they are engaged, will have to be carried out. The agreement of 18th October last stipulates essentially as follows :

That we shall examine and partly survey the River St. Lawrence from Prescott to the Head of Lachine Canal, with a view of ascertaining the character and extent of the obstructions which would have to be removed in order to procure a navigable channel throughout the whole of the Rapids, of the width of 200 feet, and of from 12 to 13 feet in depth ; and (2nd) the cost at which such improvement could be carried out ; further, that we shall fire fifty heavy submarine charges as an experiment ; that these operations shall be accomplished within the 18th October, 1854, and thereafter reported upon to the Department of Public Works ; that we shall procure the necessary boats, material, etc., and pay all expenses ; that the Commissioners of Public Works will let us have the use of the scows, anchors, etc., belonging to them, and which might be of use in these operations ; that we shall be refunded all expenses incurred, however, not beyond two thousand pounds, in instalments, during the operations, or at the close of the same ; that, upon delivery of our Report, etc., and in case the survey, etc., should not lead to any contract between the Commissioner of Public Works and the undersigned, for the improvement of the River St. Lawrence, we shall be paid a compensation of between £750 and £1250, the exact amount to be fixed by the Commissioners according to circumstances, etc. It was, at the time these stipulations were adopted, supposed by the Honorable Commissioners, as well as by ourselves, that a thorough survey would be required in but few instances ; that in almost all localities a mere examination would be sufficient, and that, consequently, the whole operation, including the experimental blasting, could easily be accomplished in one short season ; but the survey and examinations already



made by us show clearly that portions of the River which, in former official reports addressed to the Honorable Commissioners, were considered as not needing improvements, become doubtful, when the width and depth of channel above mentioned (200 feet by 12—13 feet) is contemplated, and that, in fact, great uncertainty prevails in regard to the real value and availability of all the different channels. Effectually to remove this prevailing uncertainty, will require a thorough survey to be made in a great many instances where a mere examination was originally considered sufficient. It becomes our duty, under these circumstances, most respectfully to submit the question, whether the Honorable Commissioners desire us to keep strictly within the limits of time and expenses stipulated by the original agreements, and to examine and partly survey the River, from Prescott to the Head of Lachine Canal, with a view of ascertaining the character and extent of the obstructions, etc., and in such a manner as to be able to accomplish this operation before the 18th of October next, and to report thereupon, or whether the Honorable Commissioners do not rather desire us to make a thorough survey, wherever we meet with a doubtful locality, and not to be satisfied with an examination, unless when that mode of operation leaves no doubt as to the value and availability of the channel, and to pursue those operations in such a manner as actually to ascertain the character and extent of the obstructions, and to leave nothing doubtful behind us, rather than with a view of extending them over a great portion of the River, and of thus fulfilling the letter, but not (what may well be supposed to be) the spirit of the agreement.

Submitting these two alternatives, we most respectfully beg to say, that in case the Honorable Commissioners should decide in favor of the first-named, we shall have to proceed accordingly, and only beg to propose that, in this case, the Honorable Commissioners would be pleased (in consideration of the delays which we have suffered in our preparations, by the extraordinary lateness of the season, as well as by the scarcity of labor, and especially in consideration of the enormous rise in the price of labor and material which has taken place since the original agreement was entered into) to allow three thousand pounds, currency, instead of two thousand pounds, to cover the cost of the operations. But if the Honorable Commissioners should be pleased to decide in favor of the second alternative, we would most respectfully suggest that, as a natural consequence of this decision, the original agreement be somewhat modified so as to make it stipulate essentially as follows: The modifications suggested being marked in italics.

That we shall examine and survey the River St. Lawrence from Prescott to the head of Lachine Canal, and ascertain, 1st. the character and extent of the obstructions which will have to be removed in order to procure a navigable channel throughout the whole of the rapids, of width, 200 ft., and of from 12 to 13 ft. in depth; 2nd. the cost at which such improvement could be carried out; further, that we shall fire between fifty and one hundred heavy sub-marine charges as an experiment; that we shall procure the necessary boats, materials, &c., and pay all expenses; that we shall continue these operations during the present year until the inclemency of the season compels us to suspend them, and thereafter report upon them to the Dept. of Public Works; that the Commissioners of Public Works will let us have the use of the scows, anchors, &c., belonging to them, which might be of use in these operations, such portion thereof as can be spared from the service of the Canal, and that we shall be refunded all expenses incurred, however not beyond three thousand pounds, in instalments during this year's operations, or at the close of the same, and that upon delivery of our Report for the present year, and in case the survey, &c., should not lead to any contract between the Commissioners of Public Works and the undersigned for the improvement of the River St. Lawrence, we shall be paid a compensation of £750 or thereover, the exact amount to be fixed by the Commissioners according to circumstances.



In submitting the above modifications of the original agreement to the consideration of the Hon. Commissioners, we need not insist upon the fact that we can not only derive no personal advantage from these modifications, but that on the contrary, if the Hon. Commissioners should be pleased to adopt them, they will have the effect considerably to increase our labor and responsibility, without conferring upon us the right of claiming any proportionate increase of compensation, (the exact amount of which, we confidently leave with the Hon. Commissioners to fix, upon consideration of all concluding circumstances,) and that one and all of the modifications suggested, aim only at enabling us to carry out the operations of this first year in such a manner as to place the Hon. Commissioners in possession of full and reliable information about the character and extent of the obstructions to navigation in at least a considerable portion of the Upper St. Lawrence. We are fully aware of the great difficulties to be overcome in the course of our operations, which are not only of a novel and peculiar, but also of a dangerous and arduous character, and we shall not allow ourselves to be discouraged, as long as we may rest assured that the Hon. Commissioners have full confidence in our ability and good will.

We should be happy soon to be made acquainted with the views and decision of the Hon. Commissioners in relation to the suggestions we have had the honor to submit, and shall, in the meantime, continue our operations in the Coteau Rapids, where, up to this day, we have been entirely successful.

We have the honor to remain,  
Your most obdt. servants,

MAILLEFERT & RAASLOFF.

To the Hon. the Commissioners  
of Public Works, Canada, Quebec.

MONTREAL, 29th June, 1854.

SIR,—The undersigned find that powder is at present at a very high price, and that the 6250 bls. which will be wanted for the firing of 50 heavy charges, as to agreement of October 18th, 1853, will, delivered at the Coteau, cost nearly £250, and as they understand from the Honorable Wm. H. Merritt, that powder might perhaps be obtained from the Ordnance Department at a lower price considering that it is to be used in a work of public improvement; they most respectfully beg to inquire where they will have to address themselves for the purpose of ascertaining whether and at what price the above quantity of powder of the Ordnance stores could be obtained, and also whether the Department of Public Works would be inclined to endorse a requisition from the undersigned to the Ordnance Department or to make such a requisition in their favor.

We have the honor to remain,  
Sir,  
Your most obedient servants.

MAILLEFERT & RAASLOFF.

Thos. A. Begly, Esquire,  
Secretary Department of Public Works,  
Quebec.



QUEBEC, 4th August, 1854.

SIR,—The undersigned have had the honor in their former communications to the Department especially in their letters respectively of 24th and 27th of June last, to call your attention to the insufficiency of the sum of £2000 originally appropriated for the survey of the St. Lawrence Rapids, they beg now most respectfully to lay before you the following statements of disbursements made by them up to 1st of this month, for which proper vouchers can be presented to the Department whenever desired, to wit :

For outfit.....	£1186	12	3
For surveying operations proper, April and May	£107	16	1
June.....	220	4	0
		328	0 1
Total,.....	£1514	12	4

The disbursements to be made by the undersigned in the course of the present month, for outfit and for the surveying operations proper during the month of July will amount to about £500, consequently the sum of £2000, originally estimated for these operations will be entirely exhausted by the expenditure incurred up to the 1st of August. It is, as on several occasions, we have had the honor of explaining the insufficiency of the materials furnished by the Department for these operations, which placed us in the necessity of going to the considerable expenditure for outfit above stated, and which, together with the delays occasioned by the lateness of the season, and the extraordinary high prices of labor, and all necessities, has increased the cost of these operations so much beyond what was originally contemplated.

We need not insist upon the fact, that any delay in procuring the material strictly wanted for the operations, would have occasioned a loss of time, which could not at any price be recovered, and having in view only the progress and satisfactory execution of the work, we had no hesitation in procuring the material, which we found to be absolutely necessary, convinced at the same time, that the Department would take our motives in doing so, into consideration, and not allow us to suffer pecuniary loss in consequence of the zeal with which we had tried to forward a work of great importance, in the success of which we knew the Department to take the most lively interest.

We now therefore confidently thrust ourselves upon the generosity of the Department, and respectfully solicit that they would be pleased to take off our hands the material belonging to our outfit, which has been produced and paid by us to the amount above mentioned of £1186 12s. 3d., and that consequently and to this effect, the Department would authorize us to send in Vouchers for the material and to the amount mentioned, together with an act of transfer; and that upon the vouchers, &c., having been examined and found correct, the Department would order the amount to be refunded to us. We trust that in consideration of what we have had the honor of stating above as well as in our former communications, the excellent quality and general usefulness on the Canals of the material procured by us, and also the satisfactory progress of the work, which could not have been attained without the material mentioned, nor without the most strenuous efforts and exertions from our side, the Department will be pleased to grant the above request. In case, however, the Department should not be pleased to grant this request, we beg most respectfully to solicit that for the same reasons which we have stated above, the Department will be pleased to allow the sum of £3000 instead of £2000 as originally estimated and appropriated to be spent by us on the operations towards exploring the Rapids of the St. Lawrence. We need not mention that with the present extraordinary high prices on



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every thing it will still require a most severe economy on our part to meet the expenses necessarily connected with the surveying and blasting operations, which we desire to extend as late in the season as the climate will permit, with a view of being able to submit as full and satisfactory a report as possible.

Expressing the wish that you would favor us with an early answer to this letter addressed to Coteau Landing.

We have the honor to remain,  
Sir,

Your most obedient servants,

MAILLEFORT & RAASLOFF.

Thos. A. Begly, Esquire,  
Secretary Department Public Works.

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MONTREAL, August 25, 1854.

SIR,—I have just had an interview with Mr. MacIver, and learn from him that as yet he has received no instructions from the Department, relative to the documents to be drawn up relative to the contemplated payment of £1000 to us as mentioned in the letter from the Department, of 3rd instant. Allow me to say that we are prepared to furnish two good men who are willing to sign a document to the effect, and that we shall perform the work for which the Commissioners shall advance the moneys, otherwise that they (the sureties) shall repay the moneys advanced. Mr. MacIver considers such a document sufficient, and promised to recommend to the Department this mode of arranging the matter whereby all the difficulties with which the other arrangements hitherto proposed are connected would be entirely avoided.

Allow me, under these circumstances, most respectfully to express the wish that the Department would be pleased to furnish Mr. MacIver with instructions to draw up the Documents above mentioned which will have to be signed by the two sureties.

In doing so the Department would enable us within one or two weeks from now to reap the benefit of the offer made by the Commissioners in their letter of 3rd instant.

I have the honor to remain,  
Sir,

Your most obedient servant,

W. RAASLOFF,  
of the Firm Maillefert and Raasloff.

Thos. A. Begly, Esquire,  
Secretary Department Public Works,  
Quebec,

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LIST of Instruments with which the undersigned acknowledge to have been furnished by the Department of Public Works, for use in their exploration of the Rapids of the St. Lawrence.

One 8 inch Sextant.  
One Reconnaits Telescope.  
One Surveying chain, 66 feet.  
One Ivory Scale, 3 feet to an inch.



One Transit Instrument and Stand.  
 One Circumferentor and Stand.  
 One Prismatic Compass.  
 One refreading levelling rod.  
 Two measuring Tapes.  
 One Theodolite and Stand.  
 One Spirit level do do.  
 One Beam compass.  
 One Improved Protractor.

MAILLEFERT & RAASLOFF.

Coteau Landing, 29th August, 1854.

COTEAU LANDING, 29th August, 1853.

SIR,—We have the honor, in compliance with your request in letter of 27th of July last, inclosed to send you a list shewing the whole of the instruments with which we have been furnished by the Department of Public Works. You will find this list corresponding with the one which accompanied your letter, with the exception only of the Rochon Micrometer Telescope which has been forwarded to-day, to the Department, by the Mail Steamer, well packed up and in the same state in which it was when we received it.

We have the honor to remain, Sir,  
 Your most obedient servant,

MAILLEFERT & RAASLOFF.

Thomas A. Begly, Esquire,  
 Secretary, Department Public Works,  
 Quebec.

MONTREAL, 25th August, 1854.

SIR,—I beg to inform you that I arrived here last night for the purpose of making arrangements for the transport of powder as instructed by your letter of 21st instant. I have to-day waited upon Mr. Elliot and find that he has deemed necessary to ask for further instructions from the Department; I have under these circumstances postponed my departure from here, and shall be able to attend to the arrangements necessary in case your instructions should arrive to-morrow per letter or telegraph.

I have the honor to remain,  
 Sir,  
 Your most obedient servant,

W. RAASLOFF,  
 Of the firm Maillefert and Raasloff.  
 Address: St. Lawrence Hall, Montreal.

Thos. A. Begly, Esquire,  
 Secretary Department Public Works,  
 Quebec.



## OFFICE OF ORDNANCE.

MONTREAL, 25th August, 1854.

SIR,—In acknowledging the receipt of your letter of the 21st instant, we beg to observe that the previous understanding was that the Ordnance were to supply the Department of Public Works and not private individuals, as your letter would seem to infer, with the powder required for service on the St Lawrence Rapids, but if the wish of the Commissioners of Public Works that the Powder should be issued to Messrs, Maillefort and Raasloff with the guarantee of the Provincial Government in regard to its future payment, there will be of course no objection to the arrangements, but the Powder must be supplied from Montreal as the magazine at the Coteau du Lac does not contain sufficient to meet the demand.

You will perhaps reply to this communication by telegraph.

We have the honor to be,

Sir,

Your most obedient humble servants,

(Signed,)

W. G. WULFF,  
Lt. Col. C. R. E.,

W. ELLIOTT.  
O. S. W. Q.,

WM. BELL,  
Col. Com. R. A.

M. M. BLENHAM,

The Secretary to the Commissioners of Public Works.

MONTREAL, 2nd September, 1854.

SIR,—We have the honor to enclose you five statements showing our expenditure for outfit and also for our operations towards exploring the Rapids of the St. Lawrence, up to the 1st of August, together with the original vouchers (with the exception of 8 vouchers for material and outfit belonging to statement No. 1, and of the aggregate amount of £699 13s. 8d., which were sent in to the Department under 24th June last.

Statement No. 1. shows an expenditure for material and outfit	
to the amount of .....	£1,186 12 3
“ “ No. 2. “ “ “ “ “ “	54 18 2

Makes total for material and outfit .....	1241 10 5
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Statement No. 3. shews an expenditure for April	
and May operations proper, of.....	£107 16 1

Statement No. 4. do. do. for June....	220 4 0
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Statement No. 5. do. do. July .....	240 17 4
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Makes total for operations .....	568 17 5
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Total expenditure.....	£1810 7 10
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We now beg to express the hope, that in consideration of this very considerable outlay the Commissioners of Public Works will be pleased to issue to us a certificate upon such further security as may be deemed absolutely necessary.

We have the honor to remain,  
Dear sir,  
Your most obedient servants,

(Signed,) MAILLEFERT & RAASLOFF.

Thos. A. Begly, Esq.,  
Secrétaire Department Public Works.  
Quebec.

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COTEAU LANDING, 6th Sept., 1854.

SIR,—We have the honor most respectfully to inform you that by prosecuting our survey with the utmost diligence we have now reached the lower portion of the Cascades Rapids, after having carefully examined both the present steamboat channel at Split Rock and the supposed Southern channel under Buisson Point, we may state now in anticipation of the Report which we shall have the honor of laying before the Department of Public Works, at the close of our operations, that an improvement of the River between Lakes St. Francis and St. Louis, essentially by means of removing the obstructions to navigation, appears to us practicable though connected with great difficulties and requiring considerable labor; we do not, however, expect to be able at the close of this year's operations to pronounce in favor of one certain channel through the Coteau and Cascades Rapids, but shall most likely propose to leave this question open to be decided upon by the result of future operations. We have also the satisfaction to state that although we have not entirely avoided serious accidents, our arrangements have, however, proved efficient in preventing any of them from resulting in loss of life or in serious damage to the material employed. We have not yet received the powder from the Ordnance Department, and have thus been very much delayed in commencing our experimental blasting operations; we are, however, now informed that it is ready for shipping, and shall, as soon as it shall have been received, proceed to divide our party, one portion thereof to be employed at the experimental blastings, the other at an examination of the River from Prescott downwards; this latter operation would be very much facilitated and promoted if we could have a good map of the shore line to refer to, and we beg therefore to express the wish that the Department would be pleased to furnish us with such map or maps or copies thereof, of that portion of the River as it may possess.

We have the honor to remain,  
Sir,  
Your most obedient servants,

MAILLEFERT & RAASLOFF.

T. A. Begly, Esquire,  
Secretary Department Public Works,  
Quebec.

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COTEAU LANDING, 6th Nov., 1854.

SIR,—The undersigned have the honor, in conformity with the stipulations of an agreement entered into on the 18th of October, 1853, between them and the Honorable the Commissioners of Public Works enclosed, to send you their Report upon the examination and survey of the River St. Lawrence from Prescott to the head of the Lachine Canal, and certain experimental blasting operations made during the summer 1854.

We have the honor to remain, Sir,  
Your most obedient servants,

MAILLEFERT & RAASLOFF.

Thomas A. Begly, Esq.,  
Secretary Department Public Works, Quebec.

QUEBEC, 30th November, 1854.

SIR,—We have to acknowledge the receipt of your letter of 20th instant, requesting us to furnish the Department with immediate information as to the state of the survey of the St. Lawrence rapids, detailing what is done and what remains to be done, and stating how soon the charts will be laid before the Commissioners. In reply, we beg respectfully to inform you that we have accomplished the survey and the experimental blasting operations, and closed operations on the river on the 11th instant. We have under 15th instant sent in our Report accompanied with five maps, to which reference is had in the Report. This Report we consider to be final unless the Honorable the Commissioners of Public Works should find that some information was still wanting, in which case we shall be prepared to send in such additional Report or Reports as may be required. In regard to the maps accompanying this Report we beg most respectfully to remark that they have been drawn all along with the operations, and were sent in only with a view of shewing the progress and results of the work; they are, however, correct, and will we presume be found to answer the purpose above mentioned, but owing to the want of time, they are not as elaborate and well finished as we would be able, and as we are desirous of making them; we therefore beg leave to express the wish that the Honorable the Commissioners of Public Works would allow us time and means to prepare another set of maps, which in that case we should wish to submit as the final maps.

What still remains to be done is therefore in our opinion :—

1. To prepare another set of maps as above suggested, and in case this should not meet with the approbation of the Honorable Commissioners, to finish the copies of the maps now before them.
2. To secure the stations of which we have made use of during the survey and which it may be of interest to find again at some future period.
3. To continue our observations of the bench marks until the river rises again for the purpose of ascertaining the very lowest stage of water in the rapids during the present year.
4. To lay up for the winter and properly store and secure the material which has been used in the survey, etc., in conformity with such instructions as we may receive from the Department of Public Works to that effect.

We should be happy to be informed whether or not the Honorable the Commissioners of Public Works, wish us to carry out the above specified work, and have the honor to remain, Sir,

Your most obedient servants,

MAILLEFERT & RAASLOFF.

Thomas A. Begly, Esquire,  
Secretary.



30th June, 1853.

GENTLEMEN,—I am directed to draw your attention to the accompanying advertisement from this Department, calling for tenders for the improvement of a portion of the Channel of the River St. Lawrence—a class of work in which you are stated to have had extensive experience.

I am, Gentlemen,  
Your obedient servant,

T. A. BEGLY,  
Secretary.

Messrs. Maillefert & Raasloff,  
Submarine Engineers,  
New York.

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RIVER ST. LAWRENCE.

Notice is hereby given, that Tenders addressed to the "Commissioners of Public Works," will be received at this Office, until Thursday, the first day of September next, for the opening and permanently defining a navigable Channel throughout the whole of the Rapids of the St. Lawrence, from Prescott to Montreal; such Channel to be not less than 200 feet in width, to have at no place, at low summer water, a less clear depth than 12 feet, and in those Rapids subject to much swell, not less than 13 feet.

It is to be stated in the Tenders, a bulk sum for the entire work necessary to open and permanently define a Channel, as above mentioned, and the period for its completion.

The test for the Channel being so opened, to be, the passing of as many vessels as the Commissioners of Public Works may consider necessary, each vessel to be so loaded as to draw ten feet water.

The security for the performance of the work to be ample and *bona fide*. Conditions of payment and any other information may be known by applying at this office.

Tenders to be endorsed "Tender for improving the Rapids of the Saint Lawrence."

By order,

THOMAS A. BEGLY,  
Secretary.

Department of Public Works,  
29th June, 1853.

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PUBLIC WORKS,  
QUEBEC, 5th September, 1853.

GENTLEMEN,—With reference to your tender for deepening the Channel of the St. Lawrence, I have to point out to you a discrepancy between it and the advertisement, the latter running thus :

"To have at no place, at low summer water, a less clear depth than twelve feet, and in those Rapids subject to much swell, not less than thirteen feet."



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As the Commissioners do not intend to deviate from the above mentioned terms, I am directed to request that you will state whether you will agree to your tender being altered accordingly.

I am, Gentlemen,  
Your obedient servant,

T. A. BEGLY.

Messrs. Maillefort and Raasloff,  
Sub-Engineers,  
New York.

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PUBLIC WORKS, QUEBEC,  
29th September, 1853.

GENTLEMEN,—I am directed to inform you that the Department is authorized to close with you for your proposed survey of the St. Lawrence Rapids, for the procuring of the necessary machinery, implements, &c., firing the trial charges referred to by you, and taking all possible measures to ascertain accurately and in detail the present state of each of the channels, and the amount of rock necessary to be removed, in order to improve them to the extent stated in the advertisement; the whole cost of such survey, &c., not to exceed £1200. For the expenses incurred on such survey, satisfactory vouchers will have to be produced, upon which only the payments will be made. But no money will be paid until the survey is concluded, and proper maps and sections thereof sent in to this Department, of which they will then become the property. It is also to be understood that the amount to be paid for the improvement of the channels will not be determined or settle until the result of such survey is known, as it is but reasonable that the Provincial Government should be aware of the amount of work to be done, previous to their entering into any engagement as to the sum of money to be paid for it.

I am, gentlemen,  
Your obedient servant,

(Signed,) T. A. BEGLY, *Secretary*.

Messrs Maillefert & Raasloff,  
Engineers New York.

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PUBLIC WORKS, QUEBEC,  
20th June, 1854.

SIR,—I am to apologise for not having answered your former letter, but since my absence I have been so wholly engrossed with our Annual Report, that I really have not had one moment.

I now beg to acknowledge it and yours of the 14th, I have directed the rope to be sent you.

With regard to the further examination of the Coteau Rapids you speak of, nothing will be done, if anything doubtful is left.

The object is such that, if it cannot be carried out *thoroughly* nothing is done, but as we have spoken of, the object is if possible to accomplish a channel suitable for a vessel drawing 10 feet to pass down in safety, for such, less breadth than 200



feet of a moderate straight course would not be considered ample, and now that the river is about to be opened to our American friends, the importance of it is becoming greater, should however it be found impracticable to obtain such, it will then be fixed positively what can be effected with certainty.

I need hardly point out to you how indispensably necessary it is that you should establish safe and permanent marks of reference at head of each rapids, with the view, not only of shewing during the course of operations, how the levels at the heads may be affected by our operations, but which will serve also as permanent standards, by which the trade will be governed as to what depth they can carry down at the respective levels of the river in high, middling, or low water.

I would again merely repeat our desire that the duty you are now engaged in should be done most thoroughly.

I have the honor to be, Sir,  
Your most obedient servant,

(Signed,) H. H. KILLALY.

Wm. Raasloff, Esq.,  
Coteau Landing, Canada East.

PUBLIC WORKS,  
QUEBEC, 15th September, 1854,

GENTLEMEN,—Your letter of the 2nd instant, addressed to the Honorable W. H. Merritt, has been laid before the Commissioners of Public Works by that gentleman, and in reference thereto, I am directed to acquaint you that in all matters of business between this Department and parties employed under it, the proper and legitimate mode of transacting it is directly through the Secretary of the Department; as the intervention of third parties unconnected with such public business, tends unnecessarily to retard and embarrass the regular official discharge of it.

You will be so good as to make direct application for such maps or other assistance from this office as you may desire. To such applications the Commissioners will give due attention and will comply with them when they can do so with propriety.

The Commissioners cannot admit that the Department, is in any manner accountable for the delay in testing the effects of the blasting required by your contract, as would seem to be implied by your letter. By that contract you were bound to purchase the powder yourselves. The Department interfered only at your request, to induce the Ordnance to sell powder to you out of their stores; further than which they had no connection with the transaction, nor have they any whatever, with the obtaining and transport of it.

After some explanation respecting your application for an advance of £500, it was agreed to advance £1000, and instructions were given to the law agent of the Department at Montreal, to take the necessary security therefor, in the simplest and most prompt manner, the neglecting to furnish which security is the sole cause why the sum mentioned has not been paid to you long since.

In conclusion I am directed to state that, the wish of the Commissioners is to afford you every liberal assistance in their power, towards the carrying out of your contract.

I am,  
Gentlemen,  
Your most obedient servant,

T. A. BEGLY,  
Secretary.

Messrs. Maillefert and Raasloff,  
Coteau Landing.



PUBLIC WORKS,  
QUEBEC, 20th November, 1854.

GENTLEMEN,—I am directed to request that you will furnish this Department with immediate information as to the state of the survey of the St. Lawrence rapids, detailing what is done and what remains to be done, and stating how soon the charts will be laid before the Commissioners.

I am,  
Gentlemen,  
Your obedient servant.

T. A. BEGLY,  
Secretary.

Messrs. Maillefert and Raasloff,  
Engineers.  
Coteau du Lac.

PUBLIC WORKS,  
QUEBEC, 5th December, 1854.

GENTLEMEN,—In reference to your letter of the 30th ultimo, I am directed to state that the maps furnished by you are considered quite sufficiently finished for all practical purposes ; and that in reference to the other points mentioned, all that is considered essential is that one of the officers of this Department, Mr. Sippell, should accompany you along your line of survey, for the purpose of your pointing out to him your several stations and bench marks, of each of which you will furnish him with a Schedule giving the levels. Mr. Sippell will also arrange for laying up the materials, &c.

I am,  
Gentlemen,  
Your obedient servant,

T. A. BEGLY,  
Secretary.

Messrs. Maillefert and Raasloff,  
Engineers.

*Tender for improving the Rapids of the St. Lawrence.*

MONTREAL, 24th August, 1853.

In conformity with the advertisement of 29th June last, emanated from the Department of Public Works, the undersigned hereby offer to open and permanently to define a navigable Channel through the rapids of the St. Lawrence, from Prescott to Montreal. Such Channel to be not less than 200 feet in width, and of a depth sufficient to admit the passage of a vessel drawing ten feet, at ordinary low summer water, for the sum of £30,000, the work to be completed within two years from the date of the contract, on the following conditions :

*First*,—In Mr. Samuel Keefer's Report of 25th May last, our only guide, it is stated, that in order to obtain a Channel of the desired width and depth, works of improvement are required only at the "Coteau," Cascades and "Lachine Rapids," and also that further survey and examination of these places must be made before the works of improvement can be commenced.



We cannot but agree with Mr. Keefer, in regard to the necessity of a great many more soundings at the above mentioned places, especially inasmuch as no soundings have been made across the Channel, but only in the direction thereof; consequently the width of the Channel has never been defined, and we possess no information whereupon to base an estimate of the work to be performed, in order to give a Channel of 200 feet width and of the required depth. In order therefore to obtain the information, the want of which has thus been stated, we hereby offer to make a minute marine survey of such parts of the above mentioned rapids, where an improvement is wanted and contemplated, and thus to find out and to define the location of a good navigable Channel of 200 feet width, and to take a sufficient number of cross sections, thereupon to base a proper estimate of the quantity of work to be performed, and to commence the necessary preparations for such survey immediately, and to carry out the survey in the course of next year's spring and summer-season, we further propose in connection with this survey to fire 50 heavy submarine charges with a view of testing the practicability and probable cost of removing the works and boulders forming the obstructions by means of submarine blasting; the cost of this survey etc., not to exceed the sum of £1,250, according to the following estimate submitted as No. 1.

*Second*,—That in case the above mentioned survey should prove the deepening of the Channel as required, not to be practicable for the sum above named, we shall be allowed to give up the contract, in which case we expect the Government to pay the expenses incurred in making that survey, on our returning to them all the coots, anchors and other material which shall have been furnished and prepared by us for the purpose, and that in case the contrary should be proved by the survey, the contract shall become binding for us, and the amount expended in making the survey be paid by us.

*Third*,—We expect to be allowed the use for the above named survey, as well as for the performance of the whole work, of whatever scows, anchors, chains, boats, rigging or other material proper for such use, belongs to the Board of Public Works.

In submitting the above proposals we beg to say, that we are prepared to furnish ample and *bonâ fide* security, and to enter into a contract as soon as you will notify us, that our proposals are accepted.

Our plan of operation towards the required improvement of the rapids will be to deepen and widen the Channel by removing out of it the boulders, solid rock and other material which now obstruct it, and that we do not intend to build piers across any part of the river, for the purpose of narrowing it and thereby to increase the depth of water in certain parts thereof, and that if we build any pier or piers in the river, it will be for the purpose of guiding and thereby improving the direction of the current, and of facilitating the operations of removing the obstructions out of the Channel, which will essentially consist in the blasting of rocks under water without drilling, a new method of removing rocks which has been eminently successful in the United States especially in Hell Gate near New York.

The deepening of the Channel by the removal of obstructions, offers in our opinion the following advantages :

The improvement thus produced is essentially permanent, where the bottom is rock as in this instance.

It serves to increase the discharge of water, and consequently can under no circumstances cause any overflow of land above, which on the contrary, it tends to prevent.

Its beneficial effect is certain and unquestionable, and it can never be of an injurious influence upon the direction of the current, which on the contrary it tends to keep in the direction of the Channel; nor does it deprive the public of the use of any of the other Channels, which, though of inferior qualities in some



respects, are however eminently useful and necessary for rafting and other purposes, and therefore cannot be shut up without serious injury to the main Channel by making it liable to be overcrowded.

All of which is respectfully submitted.

(Signed,)

MAILLEFERT & RAASLOFF,  
Submarine Engineers,  
64 and 66 Broadway,  
New York.

### No. 1.

*Estimate of the cost of surveying "Coteau," "Cascades," and "Lachine Rapids," etc.*

Cost of a barge to be moored in the surf, to be constructed for the purpose.....	£150	0	0
Repair of scows, etc., furnished by Government, and cost of a metallic life boat, anchors, chains, cables and other material wanted.....	150	0	0
1 foreman daily.....	10s.		
8 hands do 5s. makes.....	40s.		
Together.....	£ 2	10s.	0
Makes for 120 working days at.....	2	10s.	0
Cost of establishing proper and durable land marks (pay of surveyor included).....	75	0	0
To cover our personal and travelling expenses.....	250	0	0
Contingent expenses.....	75	0	0
Total for survey proper.....	£1000	0	0
Cost of 50 heavy submarine charges of 125 lbs of powder each at £5.....	250	0	0
Total cost.....	£1250	0	0

(Signed,)

MAILLEFERT & RAASLOFF.

Montreal, 24th August, 1853.

To the Commissioner of Public Works,  
at Quebec.

Articles of agreement entered into on the eighteenth day of October, in the year of our Lord, one thousand eight hundred and fifty-three, in duplicate between Maillefert and Raasloff, Submarine Engineers, both of New York, of the first part, and Her Majesty Queen Victoria, represented herein by the Commissioners of Public Works, of the Province of Canada, of the second part, for an examination and survey of certain parts of the River St. Lawrence, and the firing of fifty heavy submarine charges in the Rapids, &c., thereof.

It has been agreed by and between the said parties as follows:

1st. That the said parties, of the first part, shall and will examine and partly survey the River St. Lawrence from Prescott to the Head of the Lachine Canal, with the view of ascertaining (1st) the character and the extent of the obstructions which would have to be removed in order to procure a navigable



channel throughout the whole of the Rapids of the St. Lawrence, from Prescott to the head of the Lachine Canal, such channel not to be less than two hundred feet in width, to have no place at low summer water a less clear depth than twelve feet, and in those rapids subject to much swell, not less than thirteen feet; (2nd) the cost at which such improvement could be carried out.

2ndly. That the said parties, of the first part, shall fire fifty submarine charges, of one hundred and twenty-five pounds of powder each, in some part of the rapids, for the purpose of ascertaining whether the party of the first new method of blasting rocks under water can advantageously be made use of for the contemplated improvement.

3rdly. That the said parties, of the first part, shall procure or purchase all the necessary boats, materials, powder, &c., for the operations, pay all expenses of said examination, &c., as wages to men, repair of boats, &c.

4thly. That the said party, of the first part, shall carry out and accomplish these operations within one year from this day, and when they shall have been accomplished, make a full report to the Department of Public Works, accompanied with proper Charts shewing the result of the survey, &c.

5thly. That the parties of the first part also shall return in perfect good order to the Department of Public Works, such material, as scows, anchors, boats, instruments for surveying, &c., which may have been lent to them for use in these operations (as hereinafter), with the exception of such, however, as may have been lost during the operations by accident beyond their control.

And it is further agreed between the said parties that the party of the second part will let the party of the first part have the use of the scows, anchors, boats, instruments for surveying, &c., which belong to them, and which might be of use in the above mentioned examination, survey, &c., which the party of the first part have agreed to carry out (as above.)

That upon delivery of the report about the examination, &c., and the return of the material, &c., lent to them (as above), to refund to the party of the first part the expenses which they may have incurred in carrying out these operations, (as above), however, not beyond the sum of two thousand pounds, the payments hereof to be made in instalments during the operations, such as they may find that the expenses incurred by the party of the first part, and the progress of the operations will justify, or after the operations shall have been accomplished, and the payment only to be made upon the presentation of proper vouchers, with the only exception of two hundred and fifty pounds, which amount being destined to cover the travelling and personal expenses of the parties of the first part, a receipt signed by them shall be taken as good therefor.

And it is also further agreed (in case the above mentioned examination, &c., and the proposals for opening and permanently defining a navigable channel as above specified, which the party of the first part may be called upon to present to the Department of Public Works, should not lead to any contract or agreement for said improvements between the parties of the said first and second parts), the party of the second part will pay or cause to be paid unto the party of the first part, as a compensation for their labors and risks in making the said examination, &c., (as above), between seven hundred and fifty pounds, and one thousand two hundred and fifty pounds; the exact amount of this compensation to be fixed by the Department of Public Works upon consideration of all contending circumstances.



In witness whereof the parties of the first and second parts, as aforesaid, have hereunto signed their names and set their seals, and the Secretary for the said Public Works hath also signed these presents.

(Signed,) MAILLEFERT & RAASLOFF,  
HAMILTON H. KILLALY,  
Assistant Commissioner Public Works.  
THOMAS A. BEGLY,  
Secretary Public Works.

Witnesses to the signatures of the party of the first part; also, witnessess to the signatures of the Honorable Commissioners and counter signature of the Secretary of Public Works.

(Signed,) JAMES W. HARPER,  
MICHAEL WALSH,  
ARCHIBALD WALSH.

Articles of agreement and sale entered into and made in duplicate between Benjamin Maillefert and Waldimar Raasloff, both lately of New York, in the State of New York, one of the United States of America, now residing in the District of Montreal, in the Province of Canada, submarine Engineers, of the first part, and Her Majesty Queen Victoria, herein represented by the Commissioners of Public Works of the Province of Canada, of the second part, witness and declare as follows, to wit: That the said parties of the first part for and in consideration of the sum of one hundred and eighty-eight pounds nineteen shillings and four pence current money of Canada, to them in hand paid at the time of the execution of these presents (the receipt whereof is hereby acknowledged) have bargained, sold, assigned and made over, and by these presents do bargain, sell, assign, and make over unto the said parties of the second part, (thereof hereby accepting) the following boats and other craft and property belonging to them the said party of the first part, now lying and being near the Village of Coteau du Lac, in the County of Vaudreuil in the said Province, to wit: one scow, four boats, one Francis' metallic life boat, one mast, and one hundred fathoms of chain, the whole of which is fully and at large set forth in a certain statement and schedule marked A., hereto annexed, to form part thereof and signed by the parties to these presents.

And the said parties of the first part, for themselves, their heirs, executors, administrators and assigns will warrant and defend the said bargained property, goods, chattels and effects from and against all persons whomsoever.

In witness whereof the said parties to these presents have hereunto set their hands and seals and the Secretary of the said Public Works hath also countersigned these presents, this ninth day of December, 1854.

(Signed,) MAILLEFERT & RAASLOFF,  
J. CHABOT,  
Chief Commissioner Public Works.  
THOMAS A. BEGLY,  
Secretary, Public Works.

Witnesses to the signatures of Maillefert and Raasloff, the Chief Commissioner of Public Works, and counter-signature of the Secretary.

(Signed,) JAMES W. HARPER,  
J. GUY.



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SCHEDULE A.

*List of boats and other material purchased by the undersigned Maillefert and Raasloff, for use in their exploration of the Rapids of the River St. Lawrence.*

One wooden scow 35 feet long, 10 feet beam, 4 feet depth of hold, built at St. Timothy, of tamarac, decked all over, with one rudder and tiller, and salmon-tail, 4 oars, etc,

One wooden boat 38 feet long, 8 feet beam, with 2 sails, 2 masts, 2 jib-booms, 2 oars, 1 rudder and tiller, built at New Haven, Connecticut.

One wooden boat 22 feet long, flat-bottomed, with 4 oars, built of pine at Coteau Landing.

One wooden boat 16 feet long, flat-bottomed, with 2 oars, built of pine at Coteau Landing.

One wooden boat 20 feet long, flat-bottomed, with 2 oars, built of pine at Coteau Landing.

One Francis' metallic life-boat, 16 feet long, with water tight compartments and 4 oars, built at New York.

One mast for iron barge, with stays.

One hundred fathoms  $\frac{3}{8}$  inch chain, B.B. from H. 7, Wood & Co., Liverpool, entirely new.

The foregoing is the Schedule and statement referred to in foregoing bill of sale between Messrs. Maillefert and Raasloff, and the Commissioners of Public Works, Quebec.

(Signed,)

MAILLEFERT & RAASLOFF,

J. CHABOT,

Chief Commissioner of Public Works.

THOMAS. A. BEGLY,

Secretary of Public Works.

(Witnesses.)

(Signed,)

JAMES W. HARPER,

J. GUY.

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Articles of agreement and sale entered into and made in duplicate, between Benjamin Maillefert and Waldimar Raasloff, both lately of New York, in the State of New York, one of the United States of America, now residing in the District of Montreal, in the Province of Canada, Submarine Engineers of the first part, and Her Majesty Queen Victoria, herein represented by the Commissioners of Public Works of the Province of Canada, of the second part, witness and declare as follows, to wit :

That the said parties of the first part, for and in consideration of the sum of one thousand one hundred and eighty-six pounds twelve shillings and three pence current money of Canada, to them in hand paid at the time of the execution of these presents, (the receipt of which is hereby acknowledged) have bargained, sold, assigned and made over and by these presents do bargain, sell, assign and make over, unto the said parties of the second part, (thereof hereby accepting) the following boats and other craft and property belonging to them the said party of the first part, now lying and being near the Village of Coteau du Lac, in the County of Vaudreuil, in the said Province, to wit: One iron barge, three metallic life-boats, and one wooden scow or boat, also all the rigging, sails, spars, materials, and furniture belonging to the said boats and craft, also divers other materials, goods, chattels and effects, the whole of which is fully and at large set forth in a



certain statement and Schedule marked A., hereunto annexed, to form part thereof and signed by the parties to these presents.

And the said parties of the first part for themselves, their heirs, executors, administrators and assigns, will warrant and defend the said bargained property, goods, chattels and effects from and against all persons whomsoever.

Signed and sealed by the said Maillefert and Raasloff, the party of the first part, at Montreal, this ninth day of September, 1854.

(Signed,) MAILLEFERT & RAASLOFF,

(Witnesses.)

(Signed,) JOHN MONK,  
JOHN RADIGER.

Signed and sealed by the said Commissioners of Public Works, the Honorable Jean Chabot, and counter-signed by the Secretary at Quebec, this twelfth day of December, 1854.

(Signed,) J. CHABOT,  
Chief Commissioner of Public Works.

THOMAS A. BEGLY,  
Secretary Public Works.

(Witnesses,)

(Signed,) JAMES W. HARPER,  
J. GUY.

#### SCHEDULE A.

*List of boats and other materials purchased by the undersigned for use in their exploration of the Rapids of the river St. Lawrence.*

One iron barge 55 feet long, 18 feet beam,  $5\frac{1}{2}$  feet of hold in the clear, bottom and bilge of  $\frac{1}{4}$  inch, sides of 3 inch boiler plate, fastened to angle irons, with 3 bulk heads of  $\frac{1}{8}$  inch iron plate decked all over with 2 companionways, 2 hatchways, 2 cabins, 1 kitchen, 6 cleets, rudder with wheel and chain, the cabins fitted up respectively for 6 and 14 berths, built at Montreal.

One Francis' Patent metallic life boat of galvanized iron, 25 feet long, with 4 watertight compartments, cork fenders, 1 mast, 1 sail, 6 oars, 1 rudder with tiller, built at New York.

One Francis Patent metallic lifeboat, 22 feet long, with 2 watertight compartments, 4 oars, 1 rudder and tiller, built at New York.

One Francis Patent metallic lifeboat, 11 feet long, 2 watertight compartments, 3 oars, built at New York.

One wooden scow 36 feet long, 10 feet beam, 4 feet depth of hold, bottom of oak 2 inch thick, sides of tamarack 2 inch thick, decked 8 feet fore and 7 feet aft., 1 rudder with tiller and salmontail, 1 mast, 1 sail, 1 towpost, (oak) 4 oars, built at Montreal.

One Patent Capstan, (fixed on board of the iron barge.)

One smaller do. do. (do. do. 25 feet, lifeboat.)

One double Surveying wheel, (do. do. do.)

Four patent levers with racked wheels.

Thirty-two feet of cast iron racks.

Twenty square feet of  $\frac{1}{4}$  inch boiler plate.

One cooking stove, (onboard the iron barge.)



Six heavy patent blocks.  
 Six patent felt mattresses.  
 Six do. do. pillows.  
 Six do. do. life preservers.  
 Six pairs of sheets, cotton.  
 Six pillow cases, linen.  
 Fifteen pairs of blankets.  
 Twelve covers to mattresses.  
 Twelve cork jackets, life preservers.

Divers marine stores, namely : 3 boat lamps, 1 signal haulyard, 50 yards cotton rope, 1 tin can, etc.

Divers hardware, namely ; 4 large and 2 small axes, 6 taper saw files, 1 draw knife, 1 chisel, 5 augers, 1 handsaw, 1 hammer, 1 cross-cut saw, 24 spoons, 12 knives, 12 forks, 12 eggspoons, 24 teaspoons, 2 covers, etc.

The disbursements for the above materials amount to the sum of £1,186 12s. 3d., (freight and import duty included) as shown by the respective vouchers, to which reference may be had for the details, as far as the same have not been given above.

The foregoing is the Schedule and statement referred to in the foregoing bill of sale between Messrs. Maillefert and Raasloff, and the Commissioners of Public Works.

Montreal, 9th September, 1854.

(Signed,)

MAILLEFERT & RAASLOFF,

J. CHABOT,

Chief Commissioner of Public Works.

THOMAS A. BEGLY,

Secretary Public Works.

(Witnesses.)

(Signed,)

JOHN MONK,

JOHN RADIGER.

JAMES W. HARPER,

J. GUY.







